THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. 34 SEPTEMBER, 1935 No. 3

# SIALOGRAPHY*

## WITH PARTICULAR REFERENCE TO NEOPLASTIC DISEASES

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THE term "sialography" as used in this article means the roentgenographic demonstration of the ducts, ductules and parenchyma of the salivary glands by means of radiopaque substances introduced into the ducts. According to Jacobovici, Popolitza and Albu,[5] Charpy was the first to use this method for the visualization of Stensen's duct. In 1925, Bársony[1] recorded a satisfactory demonstration of an "idiopathic dilatation of Stenon's duct." Since then, other reports of sialographic examinations of normal and pathologic conditions of the parotid and submaxillary glands have appeared.[2–10,12]

The possible usefulness of sialography in the diagnosis of neoplastic diseases has been suggested, but the material thus studied has been scanty, and the data submitted have been inadequate. Jacobovici, Popolitza and Albu,[5] recorded 2 cases. Barsky and Silberman[2] reported 6 cases of tumor of the parotid gland. Feuz[4] wrote concerning one patient. Thus, a total of 9 cases has been recorded, a summary of which is presented in order to evaluate the present status of sialography in the study of neoplastic disease.

### SUMMARY OF PREVIOUSLY RECORDED CASES

Case 1 (Jacobovici, et al). A sialogram of a tumor in the parotid region showed deformity of the ducts of the parotid gland. At operation, the tumor was found to be in the parotid gland. Pathological examination of the tissue was not reported.

Case 2 (Jacobovici, et al). A sialogram of a tumor in the "hyoid region" showed a normal submaxillary salivary gland which was displaced by a soft tissue tumor in its neighborhood. A pathological examination was not recorded.

Case 3 (Barsky and Silberman). After the excision of an endothelioma of the parotid region, a sialogram showed a complete obstruction of Stensen's duct near its orifice.

Case 4 (Barsky and Silberman). A sialogram made "several" months after the roentgen treatment of a parotid tumor (the nature of which was not stated) showed a "destruction" of the larger ducts, and an absence of smaller ducts pointing to "destruction of the secreting portion of the gland."

Case 5 (Barsky and Silberman). A tumor involving the region of the accessory lobe of the parotid gland was examined by means of sialography, which revealed an absence of duct markings in the accessory lobe. A pathologic diagnosis was not given.

Case 6 (Barsky and Silberman). A rapidly growing and painful tumor in the region of the angle of the jaw was shown by sialography to be associated with an absence of fine duct markings in the parotid gland, especially in the region of the tumor. The authors' impression was that the tumor was malignant and involved the parotid gland. A pathological examination was not made.

Case 7 (Barsky and Silberman). A small, encapsulated tumor (thought to be a basal cell carcinoma) was removed from the parotid gland and postoperative roentgen treatment was given. The authors inferred that an irregular, radiopaque area seen in the sialogram was due to a defect created by the operation and that a diminished arborescence of the gland was the result of roentgen treatment.

Case 8 (Barsky and Silberman). A soft, slowly growing, painless tumor in the cheek examined sialographically showed an indistinct marking of Sten-

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sen's duct. The author stated that this was probably a benign tumor of the parotid gland. A pathological diagnosis was not reported.

Case 9 (Feuz). A swelling in the submaxillary fossa was diagnosed clinically as adenitis. A sialogram showed extensive "destruction" of the ducts indicating that the "submaxillary salivary gland was the seat of the tumor." The pathological diagnosis was mixed tumor.

Since a pathological diagnosis was reported in only 3 of the cases summarized above, it is difficult to check accurately the interpretation of the sialograms. Nonfilling and irregularity of the ducts apparently were taken as evidence of neoplastic involvement of the parotid gland. Jacobovici's case (No. 1) is of interest because the sialogram revealed that a tumor was exerting pressure upon, but was not invading, the parotid gland. Feuz's case (No. 9) also is significant in that a correct diagnosis was made by means of a sialogram. Barsky and Silberman attempted to differentiate between malignant and benign lesions, but they gave no pathologic data by which their impressions could be checked.

As judged by the data already mentioned, it seems probable that sialography is of diagnostic value in neoplastic diseases, but it has not been sufficiently used for the method to be evaluated. Therefore, further studies should be made. The present communication deals with the sialographic studies of 18 cases in which a tumor occurred in the region of a salivary gland and in which a pathological diagnosis was recorded.

## TECHNIQUE OF INJECTION

The simplicity and safety of sialography have been amply demonstrated. Various types of syringes and cannulas have been used to inject the radiopaque substances into the ducts of the salivary glands. Lipiodol and iodipin have apparently given the most satisfactory results. We have used lipiodol. Payne[8] used a glass medicine dropper with a very fine point. We found that a 2 c.c. Luer glass syringe and cannulas (1.5 cm. length) made from ordinary steel needles (Nos. 17, 18, 19 and 24) were very satisfactory. Previous preparation of the patient was not necessary. A 1 per cent aqueous solution of mercurochrome was painted around and over the orifice of the duct, following which the entire length of the cannula was inserted into the duct. The lipiodol at room temperature was injected slowly under slight pressure until the patient had discomfort in the region of the salivary gland. Usually from 1 to 1.5 c.c. of lipiodol was injected into the parotid duct and from 0.5 to 0.75 c.c. into the submaxillary duct. The injection was made in the roentgen room and stereoscopic roentgenograms were taken immediately afterward. Before the roentgen-ray exposure, the needle and syringe might, or might not, be withdrawn. The discomfort resulting from the injection was always very slight and disappeared within a few hours. A slight, transient tumefaction of the injected salivary gland was noted occasionally.

## REPORT OF NEW CASES

In the present study, two groups of tumors were recognized sialographically, depending upon whether or not there was evidence of involvement of the salivary gland.

### *Group One*

Tumors with sialographic evidence of involvement of the salivary gland.

CASE 1. Mixed tumor of parotid gland. H.M.C., Hosp. No. 41649, a Chinese peddler, male, aged twenty-nine, had a slowly growing tumor of fourteen years' duration in the right parotid region. The mass was firm, resilient, nodular, freely movable, and approximately 10×10×8 cm. in size. A biopsy secured by aspiration confirmed the clinical diagnosis of mixed tumor of the parotid gland. A sialogram showed that the inferior portion of the gland was irregular in radiodensity, and flattened out markedly by a soft tissue tumor which lay in the upper cervical region. Stensen's duct and its branches appeared normal except in the inferior portion of the gland where only a few fine terminal ducts, which seemed to enter the soft tissue tumor, were visualized. These find-

ings suggested an involvement of the gland by the tumor (Fig. 1), a fact which was later confirmed by operative and pathological data.

Case II. Mixed tumor of parotid gland. L.W.H., Hosp. No. 38023, a Chinese laborer, male, aged thirty, had a slowly growing and painless mass in the right parotid region for the past six years. It was firm, lobular, freely movable, and approximately 10×8×5 cm. in size. A clinical diagnosis of mixed tumor of the parotid gland was made. A sialographic examination of both parotid glands was carried out. On the left, the findings were normal. On the right, the parotid gland appeared definitely smaller than normal, and its inferior lobe was not visualized. There was no demarcation between it and the tumor. These observations indicated that the lower part of the right parotid gland was occupied by a tumor. The findings were confirmed at the time of operation. The pathologic diagnosis was mixed tumor of the salivary gland type.

Fig. 1. Case 1, Group One. Illustrating the involvement of the right parotid gland by a mixed tumor. The sialogram, anteroposterior view, shows the parenchyma of the gland lateral to the ascending ramus of mandible. The ducts in the upper portion are essentially normal, and the soft tissue tumor in the region of the angle of, and extending below, the mandible is visualized. The parenchyma of the gland is irregular in the radiodensity and there is no demarcation between it and the tumor. The few, poorly visualized terminal ducts of the inferior portion of the gland run into the tumor.

Fig. 2. Case 1, Group Two. Illustrating the infiltration of the tumor between the lobules of the left parotid gland. The sialogram, anteroposterior view, shows the wide separation of the glandular lobules, the contour and ducts of which are normal in appearance. There is a definite demarcation between the lobules of the salivary gland and the soft tissue tumor.

Case III. Mixed tumor of parotid gland. L.K.T., Hosp. No. 40942, a Chinese merchant, male, aged thirty-two, had a symptomless and slowly growing mass in the right parotid region for the past nine years. The tumor had been needled* repeatedly, following which ulceration had occurred. Examination showed an ulcerated mobile lobulated tumor, 14 cm. in diameter, occupying the right infra-auricular region and containing firm, soft, and resilient portions. A piece of tissue was removed from the ulcerated surface, and the pathologic examination confirmed the clinical diagnosis of mixed tumor of the salivary gland. A sialogram showed a normal Stensen's duct, an upward displacement of the whole gland and marked lateral displacement of the inferior portion. There was an irregularity in radiodensity of

* Native Chinese practitioners often resort to acupuncture.

FIG. 3. Sialogram, lateral view, of a normal parotid gland.

the parenchyma. The borders of the inferior portion of the gland were irregular and merged with the tumor. The terminal ducts were poorly visualized throughout the entire gland, which was probably due to pressure exerted by the tumor. It was assumed that the inferior lobe of the parotid gland was involved by the growth, and this was confirmed by operative and pathological data.

CASE IV. Mixed tumor of parotid gland. C.C.J., Hosp. No. 42751, a Chinese farmer, male, aged thirty-five, had a slowly growing tumor in the right parotid region for the past eleven years. The lobulated mass measured 15×8×7 cm. and its consistency varied from firmness to resiliency. It was freely movable and was situated in the posterior part of the right parotid region. The clinical diagnosis of mixed tumor of the parotid gland was confirmed by an aspiration biopsy. A sialogram indicated that Stensen's duct, its main branches, and the anterior portion of the glandular parenchyma were normal, but that the posterior portion of the parenchyma and the corresponding ductules were hazy, irregular, and merged with a soft tissue tumor. The observations pointed to an involvement of the posterior portion of the parotid gland by a tumor and confirmation was obtained by subsequent operative findings. The pathologic diagnosis was mixed tumor of the salivary gland.

CASE V. Mixed tumor of parotid gland. L.S.S., O.P.D., No. 291615, Chinese, male, aged twenty-three, had a slowly growing tumor in the right parotid region for the past seven years. A lobulated, protruding mass, approximately 12×12×8 cm. in size, occupied the right infra-auricular and upper cervical regions. It was "rubbery" in consistency and was freely movable. The clinical diagnosis of mixed tumor of the parotid gland was confirmed by an aspiration biopsy. Stensen's duct, its main branches and the contour of the salivary gland were well visualized in the sialogram. The terminal ducts were irregular and ran into a large soft tissue tumor which was continuous with the inferior portion of the gland and was pushing the main portion upward and posteriorly. These observations indicated that the tumor involved the inferior portion of the gland and this impression was confirmed by later operative findings. The pathologic diagnosis was mixed tumor of the salivary gland.

CASE VI. Adenocarcinoma of parotid gland. C.F.T., Hosp. No 44965, a Chinese cook, male, aged sixty-three, first noticed a spontaneous swelling in the right infra-orbital region six years before coming here. The neoplasm was excised one year after onset but promptly recurred. Three years after the onset of disease, a small nodule appeared in front of the right ear and grew rather rapidly. Our examination revealed a hard, fixed, non-tender mass, 3.5×3×1 cm. in size, in the right infra-orbital region. A larger tumor, 12×10×7.5 cm. in size, occupied the right preauricular, parotid, upper cervical and submaxillary regions. This mass also was hard, fixed, and non-tender. Over both

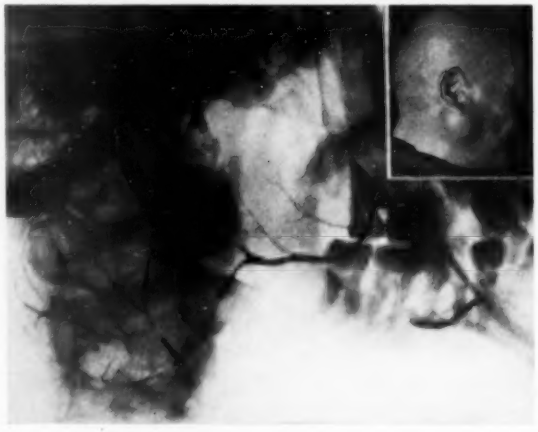

FIG. 4. Case VIII, Group Two. Branchioma of the right parotid region. The sialogram, lateral view, shows that the ducts are pushed mostly to the periphery of the salivary gland. A rarefied area in the central portion of the parotid gland is caused by the tumor, and the duct markings are absent in this region (best seen in stereoroentgenograms). Compare with the sialogram of a normal parotid gland, Figure 3.

tumors the skin was tense and bluish-red but was not adherent. The cervical lymph glands were not enlarged. The clinical diagnosis was adenocarcinoma of the infra-orbital area with regional metastasis. An aspiration biopsy from each of these tumors was positive for adenocarcinoma of salivary gland type. A sialogram showed a large soft tissue tumor in the right parotid region; Stensen's duct and its main branches appeared normal; the terminal ducts ran in all directions into the tumor and were distorted or obliterated; no demarcation between the tumor and the parotid gland was discernible. The parenchyma of the whole gland was hazy and irregular. These sialographic findings pointed to an involvement of the parotid gland by the tumor. An operation was not performed.

Case vii. Adenocarcinoma of submaxillary salivary gland. W.M.K., Hosp. No. 41672, a Chinese farmer, male, aged forty, had a slowly growing, painless tumor in the left submaxillary region for the past three years. Examination showed a hard, nodular mass, measuring 10×8×1.5 cm. in size, with slight fixation to the underlying structures. The skin appeared normal and was not adherent. Other masses were not found. The clinical diagnosis was malignant tumor of the submaxillary region. An aspiration biopsy revealed the tumor to be an adenocarcinoma. Sialographically, the ductules and parenchyma of the upper portion of the submaxillary salivary gland looked normal. The inferior part of the gland, however, was much enlarged, irregular, and did not contain visualized ducts, and there was no demarcation between it and the tumor. These sialographic findings pointed to a neoplasm involving the inferior lobe of the left submaxillary salivary gland. An operation was not performed.

### *Group Two*

### Tumors without sialographic evidence of involvement of the salivary gland.

Case i. Tumor of salivary gland region associated with eosinophilia. C.S.T., Hosp. No. 38962, a Chinese farmer, male, aged twenty-eight, had a mass of twenty years' duration on the left side of the face. The growth began as a small subcutaneous induration below the lobe of the left ear. It enlarged slowly, but for the past two years the increase in size was more rapid than previously. A similar growth appeared in the right parotid region two years before he came to the hospital. Examination showed a huge tumor occupying most of the left side of the face, the left submaxillary fossa and the left mastoid regions. It was firm, nodular, and fixed to the underlying structures and to the skin, which also was firm, rough, and thick. The right parotid region was bulging with subcutaneous masses, smaller but similar in nature to the one found on the left side. The patient's general condition was good. Over the trunk and limbs the skin was dry, hyperpigmented and excoriated, this condition being more marked on the dorsal surfaces. There was a generalized enlargement of the superficial lymph nodes.

Successive blood examinations showed a slight anemia, a moderate leucocytosis and a persistent high eosinophilia (20 to 30 per cent). Parasites could not be found. The clinical diagnosis was pachydermatocele of unusual type. Microscopic examination of tissue from the large tumor of the left side revealed a condition somewhat similar to that found in Mikulicz's disease. Bilateral sialograms were made and, on each side, Stensen's duct and its branches appeared normal. The lobules of the parotid glands were separated widely from each other, but the ducts and parenchyma were well preserved. A definite demarcation between these lobules and the soft tissue tumor was seen, indicating that the growth was outside the glandular substance and was infiltrating between the lobules (Fig. 2). A detailed description of the clinical and pathological features of this case will be included in a separate report.[11]

Case ii. Squamous carcinoma of tonsil with metastasis to the cervical lymph nodes. L.C.H., O.P.D. No. 262146, a Chinese, male, aged fifty-one, had masses of one year's duration in the right upper cervical region, associated with slight pain in the right side of the throat and head. Examination showed a hard, fixed, and slightly lobulated mass, measuring 8×6×3 cm. in size, in the right infra-auricular region, and attached to it anteriorly was a smaller mass. The overlying skin was normal. In the right tonsillar fossa, there was an ulcer 1 cm. across, covered with purulent material. On the right side, there was a slight weakness of muscles supplied by the lower branches of the facial nerve. The clinical diagnosis was malignant tumor of the tonsil with metastasis to the regional lymph nodes. A sialogram showed normal ducts, ductules, and parenchyma of the

right parotid gland with a soft tissue tumor adjacent to it, thus demonstrating that the parotid gland was not involved by the growth. A biopsy from the ulcer in the tonsillar region showed squamous cell carcinoma.

CASE III. Squamous carcinoma of infra-auricular region. C.E., O.P.D. No. 277787, a Chinese farmer, male, aged fifty-six, two years before had noticed a white papular lesion of the skin below the lobe of the left ear. This nodule grew slowly. There was no pain until twenty days ago, at which time there was spontaneous ulceration of the tumor followed by a discharge of some watery fluid. The mass was situated in the left infra-auricular region, was fixed to the subjacent structures, and measured 15×10×4 cm. in size. There were two areas of ulceration from which seropurulent material escaped. The skin over and adjacent to the mass was thickened, dull red and covered by a serous exudate. A sialogram on the left showed no abnormality except that the lower portion of the inferior lobe of the parotid gland was slightly compressed from behind by a soft tissue tumor. However, the marginal contour of the gland was well preserved. A biopsy taken from one of the ulcerations was diagnosed microscopically as squamous carcinoma.

CASE IV. Cyst of cheek. W.C.C., Hosp. No. 43470, a Chinese student, female, aged thirteen, had a gradual swelling of the left cheek for the past four months. The swelling was soft, fluctuant, and involved the whole thickness of the left cheek. The skin in this region was slightly erythematous. The clinical diagnosis was hemangioma. The lesion was treated with roentgen irradiation without improvement. A sialographic examination revealed normal Stensen's duct, ductules, and parenchyma of the left parotid gland. Subsequently, the tumor was excised and was found to be a cyst of undetermined origin, the wall of which was lined with fibrous tissue (microscopic diagnosis).

CASE V. Branchial cleft cyst. C.L.J., O.P.D. No. 286146, a Chinese student, male, aged eighteen, had a symptomless and slowly growing mass in the right submaxillary and submental regions for the past ten years. At the time of examination the mass seemed to be a cyst, and it measured 5 cm. across. On the same side, the floor of the mouth was bulging inward. Some brownish, gelatinous fluid was aspirated from the swelling. A culture of this fluid was negative for organisms. The clinical diagnosis was a cyst of the submaxillary salivary gland and ducts. A sialographic examination of the right submaxillary gland showed a normal Wharton's duct, ductules, and parenchyma except that the inferior portion of the gland was slightly pressed upon and Wharton's duct was displaced medially by an abnormal soft tissue structure. The margins of the gland were well demarcated. The mass was excised, and the pathologic diagnosis was branchial cleft cyst with chronic and subacute inflammation.

CASE VI. Lymphosarcoma of cervical region. S.K., Hosp. No. 40514, a Chinese cook, male, aged thirty-six, had a symptomless growth of two months' duration in the left parotid region. Examination showed a freely movable tumor, measuring 10×6×4 cm. in size, occupying the lower part of the left parotid region, and varying in consistency from firmness to resiliency. There was no evidence of tumor elsewhere. The clinical diagnosis was mixed tumor. A sialogram showed that the parenchyma of the gland, Stensen's duct, and the ductules were normal and that they were not connected with the soft tissue tumor. The neoplasm was excised, and the pathologic diagnosis was lymphosarcoma.

CASE VII. Tuberculosis of cervical lymphatic glands. L.T.C., O.P.D. No. 283376, a Chinese merchant, male, aged twenty-one, had masses in the left upper cervical region for the past two years. Examination showed a soft and slightly adherent tumor which was 4 cm. across and situated in the left parotid region. There were several small lymph nodes palpable on both sides of the neck. The clinical diagnosis was tuberculous cervical lymphadenitis. This was confirmed by the microscopic study of material secured by aspiration of the mass. A sialogram of the left parotid gland showed a normal Stensen's duct, ductules and parenchyma.

CASE VIII. Branchioma of parotid region. L.H.Y., Hosp. No. 44168, a Chinese house boy, male, aged fifty-nine, had a slowly growing and symptomless mass in the right parotid region for the past two years. At the time of our examination the mass was 6 cm. across, soft but fixed to subjacent structures and was apparently involving the parotid gland. There was no enlargement of the regional lymph nodes. An aspiration biopsy showed branchioma and chronic inflammation of salivary

gland tissue. A sialographic examination of the right parotid gland revealed that a portion of the parenchyma and the corresponding ducts were displaced laterally, posteriorly and inferiorly. In general, the ducts were quite distorted. A rarefied area in the central portion of the parotid gland was caused by the tumor, and the duct markings were absent in this region (seen best in stereoroentgenograms). These findings indicated that the tumor was extrinsic and lay beneath the lower part of the parotid gland (Fig. 4). This impression was confirmed at the time of operation. The pathological diagnosis of the excised tumor was branchioma.

Case ix. Adamantinoma of left maxilla. T.H.Y., Hosp. No. 45180, a Chinese farmer, male, aged thirty, had a growing mass in the left upper part of the oral cavity for the past three years. There was a "fleshy," resilient growth occupying the soft palate, tonsillar fossa, posterior portion of the upper alveolus and the adjacent cheek on the left side. There was some induration in the parotid region. Two lymph nodes, each 1.5 cm. across, were present in the left submaxillary fossa. These were firm and slightly fixed. Roentgen study of the maxilla, mandible, and paranasal sinuses showed radiopacity of the left antrum, and a small area of radiotransparency in the ascending ramus of the left side of the mandible. A sialogram, made in order to determine the nature of the local induration, showed that the left parotid gland was normal but that the middle third of Stensen's duct was poorly filled and displaced downward by a soft tissue tumor. A biopsy of the intraoral tumor showed adamantinoma.

Case x. Mixed tumor of parotid gland. C.P.S., O.P.D. No. 176231, a Chinese journalist, aged forty-three, had a slowly growing tumor in the right parotid region for the last ten years. A lobulated, firm, and moderately fixed tumor, 4×6×2 cm. in size, was found in the right parotid region. There was no enlargement of the regional lymph nodes. The clinical diagnosis was mixed tumor. Sialogram: Stensen's duct and its branches were of normal contour. An extrinsic soft tissue tumor pushed the inferior portion of the gland upward and anteriorly, causing a thinning out of the parenchyma and a crowding together of the terminal ducts in compressed portion. Subsequently the neoplasm was excised, and the pathological diagnosis was mixed tumor of salivary gland.

Case xi. Branchiogenic cyst. T.P.C., Hosp. No. 45174, a Chinese laborer, male, aged fifty-three, had a tumor in the right upper cervical region for the past five months. The tumor started as a small mass below the lobe of the right ear and grew rather rapidly. A smooth, rounded swelling, 8 cm. in diameter, occupied the upper half of the right side of the neck. The mass was tense, cystic and fixed. Other tumors were not found. A dark brown, turbid fluid was aspirated from the mass. The clinical diagnosis was branchiogenic cyst, possibly malignant. A sialogram showed that the tumor was situated below the right parotid gland which appeared normal in every respect. At operation a cyst was found which did not involve the parotid gland and the pathologic diagnosis was malignant branchiogenic cyst.

## DISCUSSION

By means of sialograms the duct, ductules, and parenchyma of the salivary glands may be visualized satisfactorily. An explanation is not offered as to why the parenchyma of the gland can be visualized by the injection of a radiopaque substance into the main excretory duct. A study of this phenomenon is being made. However, the roentgenographic shadow of the parenchyma is of considerable diagnostic importance (Figs. 1 and 2). Tumors situated in the vicinity of the gland, *without actually involving it*, may cause a defect in the glandular shadow which is frequently associated with lack of, or partial visualization of, the smaller ducts in the affected region. Usually, the margin of the gland is well demarcated, and this fact together with a uniform radiodensity of the parenchyma ordinarily signifies a secondary effect due to pressure. On the other hand, *the actual involvement of the gland* by tumor is manifested by abnormal markings of the ducts and by lack of a demarcation between the glandular parenchyma and the tumor. The ducts are irregular in their contour and distribution and may be visualized only partially if at all. Often, the parenchyma shows an irregularity in the radiodensity.

At present, sialography is a helpful but

by no means an infallible diagnostic measure. The injection of the radiopaque substance, and the taking of the roentgenograms should preferably be done by, or under the supervision of, the same persons, and the interpretation should be based upon stereoscopic roentgenograms. An accurate evaluation of the case requires correlation of the sialographic findings with the clinical and pathological data.

## SUMMARY AND CONCLUSIONS

1. The available literature concerning sialography which might have a bearing upon the study of neoplastic diseases has been briefly reviewed.

2. The technique of the injection of radiopaque substances into the ducts of the salivary glands has been described briefly.

3. Sialographic studies were carried out in 18 cases in each of which a mass was located in the region of a salivary gland. In each instance a pathologic diagnosis was secured.

4. By means of sialograms it was possible to determine whether or not the salivary gland was the seat of a given mass, and, if so, the location and extent of the involvement.

5. So far, it has not been possible to differentiate definitely between a benign and a malignant lesion involving the salivary gland.

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Vol. 34, No. 3

# ROENTGENOLOGIC BONE CHANGES IN SICKLE CELL AND ERYTHROBLASTIC ANEMIA

## REPORT OF NINE CASES*

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SICKLE cell and erythroblastic anemia are usually classified among the congenital anemias as they both show hereditary and familial tendencies. They are of particular interest to the roentgenologist as they show bone changes in certain types of cases. In the past three years 4 cases of sickle cell and 5 of erythroblastic anemia have come under my observation, all of which show roentgenologic bone changes.

### SICKLE CELL ANEMIA
### (Herrick's Syndrome)

Sickle cell anemia was first described by Herrick in 1910 under the title "Peculiar elongated and sickle shaped red blood corpuscles in a case of severe anemia." Although there is extensive literature on the subject there are comparatively few references to the roentgenologic evidence of bone changes except as seen in the skull. One of the cases presented here is of particular interest in that unusual changes are present in the long bones.

Sickle cell anemia occurs almost entirely in young negroes between the ages of one and fifteen years, and is hereditary and familial with no sex preference. It is an anemia with peculiar sickle shaped red cells which are diagnostic of the disease, but the presence of these cells alone does not constitute the disease. Sydenstricker and also Anderson and Ware report that in statistical studies of negroes in hospitals and out-patient departments they found the characteristic sickling of the erythrocytes in 5.5–7 per cent of healthy negroes with no evidence of sickle cell anemia. The condition is evidently not limited to negroes as cases have been reported in the white race by Sights and Simon and also by Rosenfeld and Pincus.

The symptoms vary considerably, but in general we find the patient complaining of weakness, easy fatigability, shortness of breath, attacks of epigastric and hypochondriac pain with nausea and vomiting. The patient has muscle and joint pains suggesting rheumatic fever, with a temperature of 101° F. to 103° F. with leucocytosis. A history of several attacks and exacerbations can usually be obtained.

Physical examination reveals an undernourished child, small for its age, with pale mucous membranes and jaundiced or greenish sclerae, indicating anemia. The tonsils are diseased and the lymph nodes are enlarged. There is usually rheumatic heart disease with some enlargement of the heart and a systolic murmur at the apex, and the lungs may show congestion from myocardial weakness. The abdomen often has an indefinite tenderness and the liver is enlarged moderately. The spleen is variable in size, splenomegaly being present in the early stages (children under four years) and an atrophic spleen in older patients with the disease of long standing (children over seven years). The genitalia are small and remain infantile after puberty. Among the older cases leg ulcers are rather common. The blood picture has the characteristic sickling of the erythrocytes which can be demonstrated by inoculating a sealed cover slip preparation and incubating it up to twenty-four hours. In some cases it can be easily seen on a stained slide. The average red count is 1,500,000 to 3,000,000 with anisocytosis and poikilocytosis. There is usually a leucocytosis of 12,000 to 15,000 and an increased platelet count.

The bones in cases of sickle cell anemia have not been studied at autopsy except

* I am indebted to Dr. Gaylord W. Graves, Medical Director of Seaside Hospital, New York City, for permission to publish Cases I through VII. Cases VIII and IX are from St. John's Riverside Hospital, Yonkers. N.Y.

in a few cases. In 1926 Graham autopsied a case of a negro man, aged thirty, and the following is an abstract of his findings.

The calvarium showed no gross abnormalities. The long bones of the legs showed extensive changes. In the femur the marrow cavity was reduced in diameter to 4 or 5 mm. due to the thickening of the cortex which averaged 1 cm. in thickness. The outer 3 mm. were natural in appearance but the inner portion had a concentric laminated structure with columns of dark red marrow tissue alternating with layers of equal width consisting of dense bone. The diaphysis of the left tibia showed elongated bulging enlargement toward the lower end with similar structural changes as those seen in the femur except for an old ulcer.

His pathological findings are as follows: "The picture is essentially that of a chronic infectious or toxic injury of the marrow tissue and medullary bone with subsequent repair processes and compensatory hyperplasia. There is focal necrosis destroying the soft tissue and injuring the bone trabeculae. The necrotic marrow is being replaced by a loose granulation tissue while bone repair is also in evidence. At times the new bone formation has proceeded so far as to narrow and distort or even destroy the original marrow cavity."

## CASE REPORTS

CASE I. E. H., colored female, aged five, admitted to Seaside Hospital of the St. John's Guild, June 28, 1929.

*Present Illness.* Patient had not been well for past year, had not gained weight and looked anemic.

*Past History.* Normal delivery and development.

*Physical Examination.* Well developed, colored female child. Lymph glands, cervical, axillary, inguinal, slightly enlarged. Small umbilical hernia. Liver palpable 1 inch below costal margin. Spleen not palpable. Tonsils enlarged. Heart and lungs normal.

*Laboratory Findings.* June 29, 1929. Red blood cells, 2,210,000; hemoglobin, 59 per cent; white blood cells, 17,600; polymorphonuclears, 28 per cent; large mononuclears, 3 per cent; lymphocytes, 68 per cent; eosinophiles, 1 per cent; sickle cells, 2 per 100 red cells. Red cells show anisocytosis and poikilocytosis.

*Roentgen Findings.* The long bones were normal and showed no evidence of rickets or other changes.

The skull in the lateral view shows thickening of the frontal bone extending from the frontal sinus upward, the thickening diminishing as it approaches the parietal suture where it becomes of normal thickness. The diploic space is obliterated so that the outer and inner tables of the skull cannot be distinguished. The thickened area has a fine grained homogeneous appearance.

The parietal bones are similarly thickened in their posterior two-thirds, the thickening extending to the occipital suture. The thickened portion is similar in appearance to the frontal bone with obliteration of the diploë, but fine vertical striations are present in the outer portion.

The occipital bone where it joins the parietals appears slightly thickened.

In the posteroanterior view the thickening involves the vertex and extends to the temporal bones which show no thickening.

*Progress.* General condition improved. Child gained weight but blood dyscrasia remained unchanged.

This case was again observed in the summer of 1931 and no additional changes were found in the skull and the blood picture was essentially the same.

*Diagnosis.* Sickle cell anemia.

CASE II. J. R., colored female, aged seven, admitted July, 1931; readmitted June, 1932.

*Past History.* Patient had been sick for one and a half years before admission, complaining of an enlarged abdomen and an anemic condition. In another hospital a diagnosis of sickle cell anemia was made and a large spleen was removed September 11, 1930, which showed the usual changes. Patient had rheumatism in December, 1929 and October, 1930.

*Physical Examination.* Colored girl, aged seven, poorly nourished, acutely ill. Breathing with difficulty, marked beading of ribs and pigeon breast. General glandular enlargement except epitrochlears. Teeth poor. Tonsils small. Mucous membranes pale. Clubbing of toes and fingers. Râles in the base of both lungs posteriorly. Heart enlarged with double mitral lesion.

Abdomen very protuberant. Liver greatly enlarged, almost to the anterior superior spine and felt slightly nodular. No fluid wave was felt but shifting dullness was present.

*Laboratory Findings.* Urine, stool, Wassermann and Schick tests were negative. Mantoux 1+. The blood picture was characteristic of sickle cell anemia and was essentially the same in 1931 and 1932 except that the icteric index in 1931 was 80, and in 1932 it was 40. Blood

count, 1932: red blood cells, 3,136,000; hemoglobin, 65 per cent; leucocytes, 19,100; polymorphonuclears, 64 per cent; large lymphocytes, 5 per cent; small lymphocytes, 23 per cent; large mononuclears, 2 per cent; transitionals, 2 per cent; eosinophiles, 4 per cent; many normoblasts and sickle cells.

*Roentgen Findings.* The skull shows flatten ing of the frontal bone. The parietal bones are much thickened throughout, with obliteration of the diploic space. The outer and inner tables of the skull cannot be differentiated, the thickened area being homogeneous, with little structure visible. The density is slightly increased and the thickening does not extend into the temporal, frontal or occipital bones.

The tibiae show anterior bowing from old rickets, but the epiphyses appear normal.

*Progress.* General condition much improved. Fluctuations in temperature up to 102° F.

*Diagnosis.* Sickle cell anemia. Chronic cardiac with double mitral lesion and aortic insufficiency with hypertrophy and dilatation.

When the patient was readmitted in 1932 her condition was unimproved and her progress in the hospital was poor. No additional changes were found in the skull or long bones. Sickle cells were still present and the blood picture was essentially the same as the year before. Two years after the splenectomy the patient was still chronically ill.

Fig. 1. Case III. Sickle cell anemia. Lateral view of the skull showing marked thickening of the parietal bones near the vertex of the skull with obliteration of the outer table.

Fig. 2. Case III. Irregular trabeculations about the elbow. Trabeculations, cortical thinning and widening of the shafts in the distal ends of the radii and ulnae.

Case III. M. N., colored female, aged four, admitted July 24, 1933.

*Present Illness.* Child had not been well for several years. Did not walk until two and one-half years of age. Received no cod-liver oil until three and one-half years old.

*Past History.* Measles at two years.

*Physical Examination.* Child looks chronically ill. Sclerae have icteric tint, mucosa pale and tonsils large and cryptic. Ribs show marked beading and flaring from old rickets. Heart shows slight enlargement to the left. Lungs clear. Spleen palpable two fingers below costal margin and liver one and one-half fingers below costal edge. Marked knock knees and sabre shins.

*Laboratory Findings.* Mantoux and Schick tests negative. Vaginal smear negative. Nose and throat smears negative. Daily urine showed trace of albumin and a few transient pus cells. Red blood cells, 2,960,000; hemoglobin, 60 per cent; leucocytes, 11,400; polymorphonuclears, 37 per cent; lymphocytes, 58 per cent; monocytes, 1 per cent; eosinophiles, 4 per cent. A few sickle-like red cells were present.

Fig. 3. Case III. Trabeculations throughout the pelvis. In the femora, cortical thinning and marked trabeculations in the distal ends.

*Roentgen Findings.* Lateral view of the skull shows the frontal bone normal in thickness and appearance. The parietal bones show marked thickening with obliteration of the diploic space so that the inner and outer tables cannot be distinguished. In the thickened parietal area the bone has a fine "grainy" structure and has the appearance of concentric layers of bone following the contour of the skull. The thickened area extends the whole length of the parietal bone. The upper two-thirds of the occipital bone is also thickened but the thickening is not as marked as in the parietals.

In the posteroanterior view of the skull the parietals show marked thickening in the vertex extending downward to the temporal bones where, at the suture line, normal thickness is present.

Both temporal bones show marked thickening with an undulating irregularity of their inner surfaces.

The long bones throughout the body have a peculiar type of striations, usually near the ends of the shafts. The humeri have striations at both ends with cross striations in their lower ends. Their upper thirds have widening of the shafts with thinning of the cortex. Elevation of the periosteum is present along the entire inner edge.

The radii and ulnae both have widening of the shaft and thinning of the cortex in their distal ends. Slight striations are present at both ends and slight periosteal elevation is present. The metacarpals have striations giving the shafts a reticular structure.

The pelvis shows marked striations with a reticular appearance. In the ilia the striations are quite prominent and are more or less fan-like in arrangement.

The femora have marked, but irregular, reticular changes in their lower thirds. Here there is cortical thinning with slight widening of the shafts.

The tibiae and fibulae have changes similar to those seen in the radii and ulnae, with widening and bulging in their lower thirds.

The centers of ossification are visualized in the heads of the humeri and femora and also in the os magnum and unciform.

Fig. 4. Case III. Irregular trabeculations in the metaphyses of the tibiae and fibulae, with cortical thinning and widening of the shafts.

The ribs and spine appear normal.

Conclusions: The changes seen in the skull are undoubtedly due to sickle cell anemia. Although some of the changes in the long bones may be attributed to rickets, in view of the findings in the skull and the pelvis and the clinical findings it appears that they must be due, at least in part, to sickle cell anemia.

*Progress.* The child gained slightly in weight and showed some improvement.

*Diagnosis.* Sickle cell anemia. Rickets with knock knees.

Case iv. C. R., colored male, aged eleven, admitted May, 1932.

*Present Illness.* Patient has been chronically ill for the past two years. Rheumatism and chronic anemia.

*Past History.* Rheumatic fever two years ago for six weeks. Measles, mumps, chicken-pox. Tonsillectomy.

*Physical Examination.* Well-nourished colored boy, aged eleven. The head is large with a circumference of 22 inches and has marked prominence of the parietal bones. Teeth show dental caries. Chest wall shows old rachitic rosary. Lungs clear. Heart not enlarged; rheumatic heart with systolic and diastolic murmur at apex. Blood pressure 120/74. Abdomen and extremities negative.

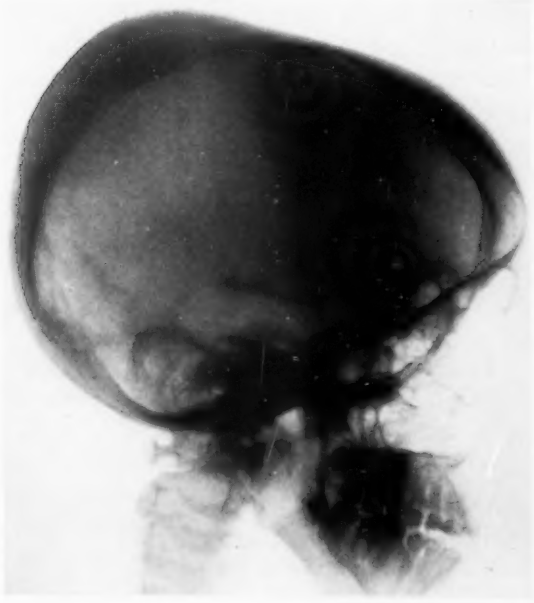

Fig. 5. Case iv. Sickle cell anemia. Enormous medullary thickening of the parietal bones with vertical striations. Thickening in the frontal region and general enlargement of the skull.

Fig. 6. Case iv. Posteroanterior view of the skull showing thickening in the vertex.

*Laboratory Findings.* Urinalysis negative. Schick and Mantoux negative. Nose and throat cultures negative. Blood calcium, 9.6 mg. per 100 c.c. of blood. Blood phosphorus, 5.8 mg. per 100 c.c. of blood. Red blood cells, 3,350,000; leucocytes, 20,000; polymorphonuclears, 69 per cent; large lymphocytes, 5 per cent; small lymphocytes, 21 per cent; eosinophiles, 3 per cent; basophiles, 2 per cent. Smear showed numerous sickle cells.

*Roentgen Findings.* Long bones show no changes from rickets.

The skull is quite large and unusual in shape and appearance, with prominence of the parietal bones. The frontal bone is much thickened in its upper two-thirds with obliteration of the diploic space. The thickening extends to, but not through, the frontoparietal suture. The thickening is uniform and, except for a slight grainy appearance, shows no particular structure. The density is normal. The parietal bones are markedly thickened and in their thickest portions measure 1 1/8 inches. The diploic

space is obliterated so that the inner and outer tables cannot be distinguished. Vertical striations are present in the outer anterior portion of the thickened area. Here there is uniform increased density due to the marked thickening. The thickening extends through the parieto-occipital suture to the upper half of the occiput where it becomes progressively less. There is also some thickening of the upper halves of the temporal bones.

Conclusion. The marked thickening of the calvarium occurring in this negro boy is typical of sickle cell anemia.

*Progress.* No change in weight. Frequent fluctuations in temperature as high as 103° F. on one or two occasions.

*Diagnosis.* Sickle cell anemia. Acute rheumatic fever. Rheumatic carditis.

### ERYTHROBLASTIC ANEMIA
### (Cooley's Anemia)

Erythroblastic anemia was first described by Cooley and his coworkers in 1927. He singled it out of the group of congenital anemias as a distinct clinical entity. The subject was recently reviewed by Baty, Blackfan and Diamond and cases have been reported by LeWald, Friedman, Karshner, Mandeville, Rose, Crawford and Williamson, Vogt, and others.

Erythroblastic anemia occurs largely in infancy and early childhood. It has a high mortality rate and is characterized by a congenital, familial and racial incidence. It occurs in the Mediterranean races, particularly among the Italians and Greeks.

Physical examination reveals an anemic child with mongoloid facies. The sclerae have an icteric tint and the skin a muddy yellow discoloration. The skull may appear large from thickening and the malar eminences are prominent. The heart may have a murmur at the apex and show some enlargement. Palpation of the abdomen reveals a large spleen and some enlargement of the liver.

The blood picture is that of a hemolytic anemia with a high percentage of erythroblasts and immature red cells, which is characteristic of the disease. Leucocytosis of varying degree is present. Reticulated cells are increased in number. The red blood count is usually between 1,500,000 and 3,500,000 per c. mm. The color index is low. The predominating red cell is large with an uneven distribution of hemoglobin and it frequently has a nucleus. Microcytes are also seen. Normoblasts are seen in large numbers with a few megaloblasts. Removal of the spleen causes a large increase in the number of nucleated red cells. Cooley in 1932 stated: "We have come to believe that splenectomy in addition to relieving the child of the burden of an enormous spleen may retard the progress of the disease."

The bones throughout the body show very striking roentgenologic changes. The calvarium of the skull is thickened and the long bones show thinning of the cortex with reticular striations throughout the marrow cavities from hyperplasia of the marrow.

The bone pathology has been described by Witwer and Lee, Friedman, Karshner, Schultz, and others, who had cases which came to autopsy. Their findings were quite similar.

The fundamental changes in the skull and long bones were similar in character. Mandeville, quoting from Schultz, states: "There was a partial replacement of cellular marrow by cellular connective tissue of the osteoid type, and he interpreted these changes as due to an aplasia of the erythroblastic marrow and a hyperplasia of the leukoblastic marrow. The actual cellular connective tissue of osteoid type was taken as evidence of beginning exhaustion of the hyperplastic process present."

Mandeville goes on to state, "Cooley . . . explains that these changes in the bones are the result of the reaction of the marrow to prolonged over-stimulation, the marrow having been over-stimulated to compensate for the chronic hemolysis. The hyperplasia of the marrow begins before the cortex is firm enough to stop the overgrowth of the marrow."

CASE V. M. B., female, aged eleven, born of Italian parentage, admitted August 6, 1933.

*Present Illness.* Patient had been in apparent good health until about three years ago. Four years ago she had a fracture of the left arm and one year later had a dislocation of the right wrist. Patient was admitted to the hospital with pathological fractures of the left radius and ulna with a general debilitation from chronic anemia.

*Past History.* Pneumonia at eleven months. Chicken-pox at two years. Measles at three years. Whooping cough at five years. Patient's brother died at one and a half years of age from Cooley's anemia. No other history of importance could be obtained.

*Physical Examination.* The patient has rather characteristic mongoloid facies, is pale and has a yellowish color. Lymph glands are slightly enlarged. Tonsils hypertrophied and cryptic. Heart enlarged to the left, with rough systolic murmur at the apex transmitted to the axilla. The lungs are clear to auscultation and percussion. The abdomen on palpation revealed a greatly enlarged spleen with firm edge which filled the left upper quadrant. The liver was easily palpated below the costal border and was tender.

*Laboratory Findings.* Urine negative. Mantoux, Schick and Wassermann tests negative. Blood calcium 11.1 mg. per 100 c.c. of blood. Blood phosphorus 5.40 mg. per 100 c.c. of blood.

| *Blood Count* | *6-6-33* | *7-7-33* | *8-3-33* |
|---|---|---|---|
| Hemoglobin | 65% | 65% | 50% |
| Red blood cells | 4,140,000 | 4,310,000 | 3,050,000 |
| White blood cells | 6,760 | 14,200 | 10,700 |
| Polymorphonuclears | 69% | 75% | 65% |
| Large lymphocytes | 7% | 2% | 3% |
| Small lymphocytes | 20% | 20% | 31% |
| Transitional cells | 1% | 1% | Myelocytes 1% |
| Eosinophiles | 1% | 1% | |
| Lymphoblasts | 2% | 1% | |
| Normoblasts | 1 in 500 R.B.C. | 8 to 100 W.B.C. | 9 to 100 W.B.C. |

All blood smears showed marked polychromatophilia, poikilocytosis and anisocytosis.

*Roentgen Findings.* Films of the skull show a very marked thickening of the frontal bone. There is thinning of the inner and outer tables with obliteration of the diploë. The general appearance of the bone is somewhat sandy in structure and in the outer portion of the thickest area vertical striations are present. The thickening extends from the sinus to the parietal suture. Slight thickening is present in the upper anterior portions of the parietals and in the upper portions of the occipital and temporal bones. In the parietal bones the sandy appearance is visible with no vertical striations.

All of the other bones of the body show very striking changes with trabeculations in varying degrees throughout all of them with the exception of the tarsal and carpal bones. In these bones they are only occasionally seen.

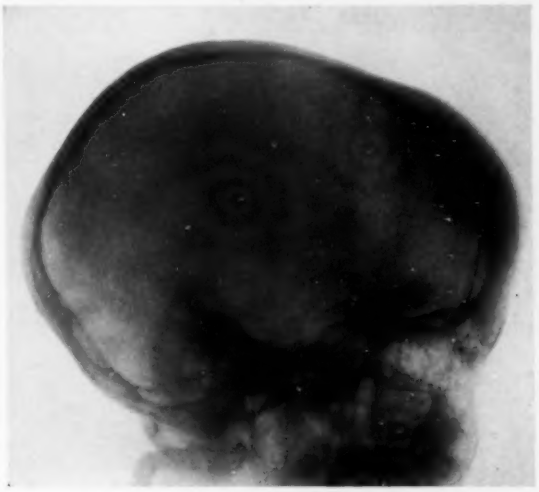

Fig. 7. Case v. Erythroblastic anemia. Marked medullary thickening of the frontal bone with typical vertical striations.

In the ribs there is cortical thinning and the trabeculations have a lacy appearance throughout the medullary cavity. In the scapulae the reticulation is seen in their upper portions, and in the pelvis principally in the ilia and about the acetabula. Similar changes are present in the dorsal and lumbar vertebrae.

The long bones have trabeculations in varying degrees seen principally in the ends of the diaphyses. In the lower ends of the humeri, femora, tibiae and fibulae there are trabecula-

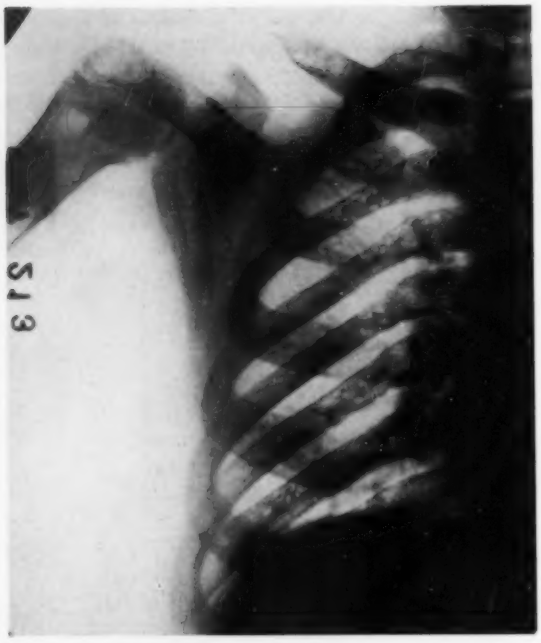

Fig. 8. Case v. Lacy trabeculations in the ribs and striations about the shoulder.

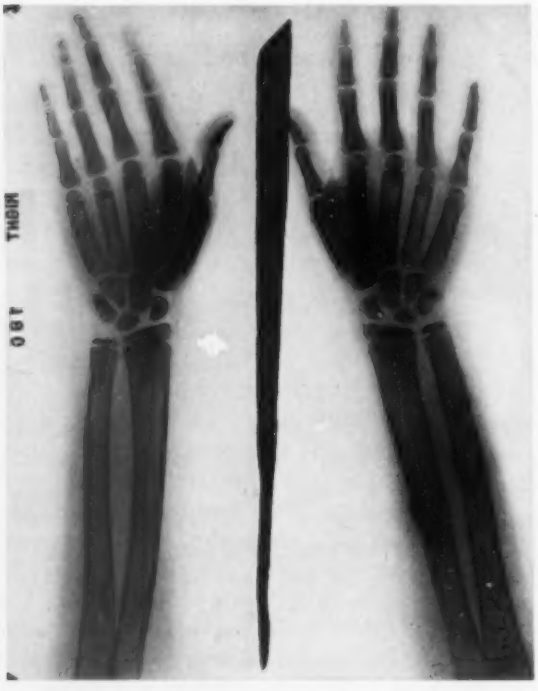

Fig. 10. Case v. Trabeculations and cortical thinning in the forearms, with pathological fractures of the left radius and ulna. Similar changes are present in the metacarpals and phalanges.

Fig. 9. Case v. Transverse striations in the diaphyses at the elbow.

tions arranged more or less at right angles to the shafts. In the radii and ulnae the trabeculations are present in the proximal three-fourths. The hands and wrists show marked widening of the shafts of the metacarpals and thinning of the cortex with a few cross striations. In the phalanges the striations tend to follow the line of the shaft with no definite thinning of the cortex.

The lower ends of the radii, ulnae, fibulae, tibiae, have thinning of the cortex with wid-

Fig. 11. Case v. Trabeculations throughout pelvis and in the lumbar vertebrae and upper femora.

ening of the shaft giving a tubular appearance, while the metacarpals are widened throughout their entire length.

This case is unusual in that there are pathological fractures of the left radius and ulna just distal to their mid-portions. These show good union by callus without deformity. Some periosteal elevation occurred about both fractures.

The only reticular changes present in the epiphyses are seen in the epiphysis at the distal end of the left radius. The epiphyseal-diaphyseal junctions and joints appear normal. There is no evidence of periostitis.

The bone changes are characteristic of those seen in erythroblastic anemia.

*Progress*. Course in hospital uneventful with normal temperature.

*Diagnosis*. Patient presented typical findings of erythroblastic anemia.

Case vi. G. G., female, aged two, born of Italian parents, admitted August, 1932, and again in June, 1933.

*Present Illness* (1932). This case had been in another hospital where a diagnosis had been made of familial hemolytic anemia (Cooley's).

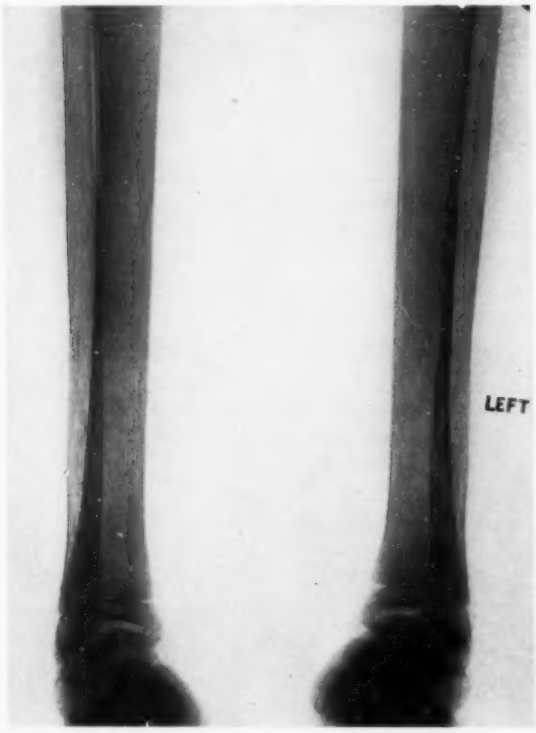


Fig. 12. Case v. Irregular trabeculations in the tibiae and fibulae with cortical thinning and widening of the shafts.

Fig. 13. Case vi. Erythroblastic anemia. Irregular trabeculations with cortical thinning and widening of the shafts in the metacarpals and phalanges.

A splenectomy had been performed and she required several blood transfusions, but none had been given in the past six months.

*Past History*. Birth and development normal. There was no icterus neonatorum or hemorrhagic tendency since birth. She has had no childhood diseases or operations other than the splenectomy.

*Physical Examination*. A pale white child with slight icterus. Heart normal except for slight systolic murmur at apex. Abdomen shows a scar from splenectomy, otherwise negative. Teeth need attention. Tonsils slightly enlarged. Nutrition is fairly good.

*Laboratory Findings*. Schick and Pirquet tests negative. Urine showed slight trace of albumin. Blood calcium (1933) 10.8 mg. per 100 c.c. of blood. Blood phosphorus (1933) 6.4 mg. per 100 c.c. of blood.

| *Blood Count* | *8-17-32* | *7-13-33* |
|---|---|---|
| Hemoglobin | 40% | 43% |
| Red blood cells | 2,240,000 | 2,490,000 |
| White blood cells | 25,700 | 10,920 |
| Polymorphonuclears | 66% | 68% |
| Lymphocytes | 30% | 24% |
| Transitional cells | 1% | 6% |
| Eosinophiles | 2% | 2% |
| Microcytes | 1% | |
| Immature red blood cells | 50,800 per c. mm. | 21,680 per c. mm. |
| Normoblasts | 92% Platelets | 256,000 per c. mm. |
| Megaloblasts | 4% | |
| Other forms | 4% | |
| | Anisocytosis<br>Polychromatophilia<br>Stippling | Anisocytosis, trend to macrocytosis and central pallor |

*Roentgen Findings* (1932). Films showed slight thickening of the mid-portion of the frontal bone with slight tendency to vertical striations. The metacarpals and phalanges showed a slight reticular structure throughout. Other bones normal.

*Progress.* Temperature normal except for two rises to 100° F. There has been no obvious change in her condition. Gained one pound in weight. Color remained the same. Appetite good.

The patient returned about one year later (June, 1933). She had a persistent low hemoglobin and continued to be jaundiced in spite of iron and liver therapy during the past year. Her appearance was that of a well-nourished, chronically ill child. Her facies now had a typical mongoloid appearance.

*Roentgen Findings* (1933). Films of the skull show marked thickening of the frontal bone and the adjoining portions of the parietal and temporal bones. The thickening becomes less as it extends toward the parietal and temporal areas.

The diploic space is obliterated so that the outer table cannot be distinguished. The inner table is very thin. The frontal and parietal bones have closely spaced vertical striations throughout the thickened areas. Otherwise, the bone structure in the diploic space appears quite homogeneous.

No other changes are present in the skull.

All the other bones of the body showed varying degrees of structural change with trabeculations.

In the clavicles, scapulae, ribs, vertebrae and pelvis irregular trabeculations are present. In the ilia the trabeculations have a fan-like arrangement.

The long bones of the legs and arms have slight thinning of the cortex, while trabeculations and cross striations are seen principally in the ends of the shafts and in the cancellous portions of the bones. The radii, tibiae and fibulae have some widening of their shafts.

In the hands the carpals show slight changes and the metacarpals and phalanges have widened tubular shaped shafts with thin cortex and a lacy arrangement of the trabeculations throughout.

The epiphyses of the various bones show no changes and the diaphyso-epiphyseal junctions are normal. The joints are normal and no periosteal changes are noted.

The bone changes are typical of those seen in erythroblastic (Cooley's) anemia.

*Progress.* Child active and bright. Temperature daily elevated to 100–100.5° F. She has gained 3 pounds in weight. Patient shows a slight improvement.

*Diagnosis.* Erythroblastic (Cooley's) anemia.

Case vii. C. A., female, aged twenty months, born of Italian parents, admitted June 16, 1933.

*Present Illness.* History obtainable dates beginning of illness at nine months of age. The patient is thin and pale with large abdomen. Has been in another hospital with a diagnosis of anemia and bronchopneumonia. Spleen was much enlarged at that time, liver two fingers below costal margin. Chest showed infiltration at both bases. Long bones negative. Child received three blood transfusions, two of 200 c.c. and one of 500 c.c. Type of blood dyscrasia not definitely diagnosed.

*Past History.* Measles and pneumonia April, 1933.

| *Blood Count* | *6-22-33* | *7-3-33* | *7-31-33* | *8-16-33* |
|---|---|---|---|---|
| Red blood cells | 2,140,000 | 2,370,000 | 2,920,000 | 3,570,000 |
| Hemoglobin | 45% | 43% | 42% | 50% |
| White blood cells | 10,840 | 14,640 | 9,160 | 16,800 |
| Polymorphonuclears | 33% | 38% | 38% | 46% |
| Large mononuclears | | | 2% | 3% |
| Lymphocytes | 62% | 59% | 57% | 47% |
| Transitional cells | 2% | 2% | | |
| Myelocytes | 1% | | | 1% |
| Eosinophiles | | 1% | | 1% |
| Basophiles | | | 1% | 1% |
| Lymphoblasts | | | 2% | 1% |
| Myeloblasts | 2% | | | |
| | 2 normoblasts per 100 W.B.C. | 7 normoblasts per 100 W.B.C. | 23 normoblasts per 100 W.B.C. | 15 normoblasts per 100 W.B.C. |

All smears showed anisocytosis with tendency to microcytosis; poikilocytosis and polychromatophilia; severe secondary anemia.

*Physical Examination.* Pale Italian child, nourishment only fair. Tonsils moderate size. Teeth present. No enlargement of lymphatic glands. Heart and lungs normal, abdomen large, spleen down to level of umbilicus. Liver felt about two fingers below costal margin. No edema.

*Laboratory Findings.* Wassermann negative. Schick and Mantoux negative. Urinalysis and Pirquet negative.

*Roentgen Findings.* Films of the skull showed a slight tendency to thickening of the frontal bone. Frontal suture not closed. Skull otherwise normal. The metacarpals had a slight widening of the shafts with thinning of the cortex and a fine reticular structure in the medullary cavity. The other long bones appeared normal. No evidence of rickets.

*Progress.* Following transfusion the child gained weight steadily, about 3 pounds in all. Temperature 100°+. Pulse 110–130 daily. July 13, 1933, 200 c.c. of blood given by transfusion; the same amount again on August 15, 1933.

*Diagnosis.* Cooley's anemia.

Case VIII. R. S., white male, aged nine, English-Irish parentage. Admitted January 4, 1933, to St. John's Riverside Hospital.

*Present Illness.* Patient was taken sick in January, 1933, with a profuse hemorrhage from the nose and mouth. Continued to get worse and was sent to the hospital for transfusion.

*Past History.* Epistaxis, mild in nature, over a period of years. Had pertussis, varicella, measles, mumps and diphtheria. Acute tonsillitis several times. Family history negative.

*Physical Examination.* Nine year old boy confined to bed in a semi-comatose state. Conjunctivae pale, sclerae slightly yellow. Tonsils hypertrophied and diseased. Throat moderately inflamed. Chest clear with no râles. Heart not enlarged, systolic murmur in mitral area transmitted to axilla. Liver and spleen enlarged three fingers below costal margin. The inguinal, axillary, and posterior cervical lymph nodes enlarged.

*Laboratory Findings.* Urinalysis and blood culture negative. Patient had five transfusions.

*Roentgen Findings.* Films of the skull show thickening of the posterior three-fourths of the frontal bone. The diploic space is obliterated by bone of homogeneous density but granular in appearance. The outer table is obliterated in the thickest portion and is very thin toward the edges. The inner table is normal in thickness.

The other bones of the skull and the long bones are normal.

A complete examination of the bony skeleton was not made.

*Progress.* Temperature on admission 101.8° F. with subsequent fluctuations up to 100° F. The patient, during a three months' stay in the hospital, had five transfusions and showed a continued improvement.

At the end of one year and three months no erythroblasts were found in the blood smear and the red count and hemoglobin showed a fairly marked improvement. The sclerae were still jaundiced. The patient is now active and feels well.

*Diagnosis.* Erythroblastic anemia.

Case IX. J. B., female, aged three years,

| *Blood Count* | *1-11-33* | *3-9-33* | *6-8-33* | *4-10-34* |
|---|---|---|---|---|
| Hemoglobin | 48% | 60% | 48% | 65% |
| Red blood cells | 2,800,000 | 3,660,000 | 2,760,000 | 4,150,000 |
| White blood cells | 15,300 | 12,000 | 7,900 | 14,000 |
| Polymorphonuclears | 70% | 75% | | 64% |
| Basophiles | ½% | | | 3% |
| Lymphocytes | 14% | 22% | | 31% |
| Endothelial leucocytes | 2% | | | |
| Metamyelocytes | 10½% | | | |
| Myelocytes | 3% | | | 1% |
| Large mononuclears | | 1% | | |
| Transitional cells | | 2% | | 1% |
| | Normoblasts 14 per 100 w.b.c. | | Normoblasts 1 per 100 w.b.c. | No normoblasts |
| | | | Anisocytosis | Anisocytosis |
| | | | Poikilocytosis | Poikilocytosis |
| | | | | Microcytes numerous |

1-11-33. Platelets were present in unusual numbers. Erythrocytes showed very marked anisocytosis with numerous macrocytes and microcytes. Also marked polychromatophilia and achromia. Fourteen erythroblasts were seen per 100 leucocytes divided as follows: 5 microcytes, 1 macroblast, 8 normoblasts.

four months, born of Italian parents, admitted April 27, 1934.

*Present Illness.* This patient had pallor, weakness, anorexia, and has been anemic for the past year. She tired easily. She had no childhood diseases, was breast fed and has been taking orange juice and cod-liver oil. Her brother died at the age of thirteen, "a cardiac" death but he acted the same way this patient does. He probably died of erythroblastic anemia.

*Physical Examination.* Well-developed female Italian child, anemic with pasty yellow skin and a mongoloid facies. Bluish-yellow tinge to sclerae, conjunctivae pale, mucosa of mouth very pale. Full dentition, gums pale but no evidence of a lead line. Chest has a slight rachitic rosary, lungs normal. Heart slightly enlarged, systolic murmur at apex and loud systolic murmur in aortic area. Abdomen —spleen enlarged two and one-half fingers and liver three fingers below costal margins. Extremities normal. Neurological findings normal.

*Laboratory Findings.* Urine showed occult blood and a very faint trace of lead. Wassermann negative. Blood count: May 1, 1934. Hemoglobin 35 per cent; erythrocytes, 2,960,000; platelets, 240,000; leucocytes, 11,800. Differential: lymphocytes, 47 per cent; neutrophiles, 50 per cent; basophiles, 3 per cent; normoblasts, 7 to 100 white blood cells and megaloblasts 5 to 100 white blood cells. The blood smear showed marked achromia, poikilocytosis and anisocytosis and polychromatophilia. Numerous Cabot's rings and Howell bodies. Stippled red cells were very numerous. No reticular cells present. Fragility test 0.040 -0.032. Sediment test 8 mm. per hour.

*Roentgen Findings.* The skull has marked thickening of the frontal and parietal bones. The left parietal is 1.3 cm., the right parietal 0.8 cm. and the frontal bone 1.1 cm. thick. The diploë is obliterated and the left parietal has a blotchy vacuolated appearance. The long bones have varying degrees of reticular striations. Some cortical thinning is present in the tibiae. The long bones show no evidence of rickets or of lead.

*Comment.* The clinical and roentgen findings are typical of erythroblastic anemia and the condition cannot be attributed to lead poisoning. The patient showed no clinical or roentgenological evidence of lead poisoning, though numerous stippled red cells were found and a very faint trace of lead was found in the urine. A blood transfusion of 250 c.c. was given with temporary improvement of the blood picture. Three months later the blood picture was about the same as when the patient was originally seen and her condition remained unimproved.

## SUMMARY

1. The four cases of sickle cell anemia showed thickening of the frontal, parietal, occipital and temporal bones, with thinning of the inner tables and very thin or absent outer tables.

2. The skull changes found in sickle cell anemia and erythroblastic anemia are so similar in the above cases that they cannot be differentiated by roentgen examination alone.

3. Long bone changes were found in only one case of sickle cell anemia (Case III). They consisted of cortical thinning, expansion of the shafts and medullary trabeculations. Striations were also present in the pelvis and scapulae. The bone changes seen are not typical of sickle cell anemia alone but also resemble erythroblastic anemia.

4. The five cases of erythroblastic anemia showed bone changes in varying degrees, depending on the age of the patient and the duration and severity of the disease.

5. Three of the erythroblastic cases (Cases V, VI, IX) showed thickening of the skull and extensive changes in the long bones and other bones of the skeleton.

6. The earliest definite bone changes found in erythroblastic anemia occurred in the metacarpals and skull (Cases VII and VIII).

7. Four of the cases of erythroblastic anemia occurred among children of Italian parentage. All four cases of sickle cell anemia occurred in negro children.

8. Case VIII has been presented because it shows that the presence of erythroblasts, even for a relatively short time, produces medullary thickening of the skull. It is also interesting that this condition occurred in a child of English-Irish parentage while it is generally accepted that this occurs only in the Mediterranean races.

9. The bone changes found on roentgen examination in sickle cell anemia and erythroblastic anemia are very similar and are not alone diagnostic of either condition.

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# BONE CHANGES OF LEUKEMIA IN CHILDREN*†

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THE diagnosis of leukemia is relatively simple when the characteristic clinical picture is present, that is, a rapidly progressing anemia, hyperpyrexia, an increased bleeding tendency, enlargement of the spleen and in the peripheral blood a large number of leukocytes, the majority of which are young forms. The manifestations of the disease are frequently atypical, however, and there may be considerable diagnostic difficulty. Aleukemic leukemia presents the greatest difficulties. In this form, the disease is apt to progress more slowly and the symptoms tend to be less well defined. Roentgen examination of the skeleton, in addition to the other clinical and laboratory findings, may be helpful in arriving at the correct diagnosis.

FIG. 1. A case of lymphoid leukemia in a boy of four years. Note the narrow zone of diminished density just proximal to the metaphyseal margins, at the lower ends of the femora and upper ends of the tibiae. An early case.

During the past six years in 60 cases of leukemia, roentgenograms have been made of part or all the skeleton in 43 patients. This discussion is based on the findings in these roentgenograms.

The most frequent change was one to which we have seen no previous reference. This was a narrow, transverse zone of diminished density just proximal to the metaphysis of the long bones as illustrated in Figures 1, 2 and 3. This zone or line varied from 2 to 5 mm. in width and was most marked in bones where growth is rapid as in the lower ends of the femora and tibiae. It seemed relatively more prominent as the disease progressed. The line was present in the bones of 70 per cent of the total 43 cases. It was present in the bones of 87 per cent of the patients (16 in number) under three years of age and of 86 per cent of those under six years (29 in number). In attempting to analyze the occurrence in the different types of leukemia, it was found that the zone was present in 80 per cent of the cases of myeloid leukemia and in 65 per cent of the cases of lymphoid leukemia.

This zone of diminished density is not peculiar to leukemia and its production is not entirely clear. Infiltration and erosion of bone by masses of leukemic cells prob-

FIG. 2. Same case as shown in Figure 1.

* From the Infants' and Children's Hospitals and the Departments of Pediatrics and Roentgenology of the Harvard Medical School, Boston. Read at the Thirty-fifth Annual Meeting, American Roentgen Ray Society, Pittsburgh, Pa., Sept. 25–28, 1934.
† The study on which this report is based was made possible, in part, by a grant from the Proctor Fund of the Harvard Medical School for the study of chronic diseases.

ably plays some part, particularly in those instances where it is most marked. Microscopic sections of some of these bones showed leukemic infiltration in the region bordering the metaphysis, but the masses of infiltrating cells were not definitely greater than in other regions.

The line of rarefaction is very similar in location and in appearance in the Trümmerfeld zone which is demonstrable in roentgenograms of the bones in scurvy. A similar line has been present in roentgenograms of the bones of a few patients who were thought clinically to have aleukemic leukemia, but in whom no evidence of the disease was found at necropsy. Septicemia was the cause of death in these patients. It has been demonstrated also in 2 patients with no evidence of leukemia, one, a three year old child with streptococcus meningitis, and the second, a four year old child with a cerebellar tumor. The occurrence of this zone of diminished density in these varied disease conditions, each of which is accompanied by a profound metabolic dysfunction, suggests that the rarefaction is produced, in part at least, simply by disturbance of bone growth. This disturbance of bone growth might be a part of the general disturbance involving the entire body or the result of interference in growth locally by infiltrating leukemic cells. It seems probable that both factors, the local infiltration of bone by leukemic cells and the general metabolic dysfunction, play a part in producing the change demonstrable in roentgenograms.

Fig. 3. A case of myeloid leukemia in a girl of two years. More advanced stage. This roentgenogram was made two weeks before death.

Fig. 4. Legs of a girl aged eight years with aleukemic myeloid leukemia. Note the advanced degree of irregular cortical absorption and infractions through the lower ends of the tibiae.

Periosteal infiltration in leukemia demonstrable roentgenographically has been reported by Poynton and Lightwood,[5] Ehrlich and Forer,[2] Karshner,[3] and others. This was relatively rare in our cases. In 2 patients, there was slight elevation of the periosteum in one or more of the long bones.

Another rare type of bone changes is illustrated in Figures 4, 5 and 6. These roentgenographic changes are much more striking in appearance than those previously mentioned. Similar cases, in some of which spontaneous fractures occurred, have been recorded by Karshner,[3] Patrassi,[4] Smith,[6] Sutton and Bosworth,[7] and Trusen.[8] The erosion of bone sufficient to produce this extraordinary roentgenographic picture

FIG. 5. Forearms and hands of the same case as shown in Figure 4. There is marked erosion of the cortex of the distal ends of the bones of the forearm as well as the metacarpals and phalanges.

was present in only 2 of our patients. One, a boy of six years with aleukemic lymphoid leukemia, was thought for some months to have osteomalacia (Fig. 6). The other, a girl of eight years* with aleukemic myeloid leukemia, first complained of pain in the extremities. Although there was a severe anemia and a leukopenia no abnormal leukocytes were found in the peripheral blood during the first four months of the illness. In films of the maxillary sinuses, taken in an effort to locate a focus of infection, the frontal bones were seen to be very granular and porous. Films of the entire skeleton were then made and all the bones were found to be involved, including the small bones of the hands and feet (Fig. 5). There was extreme, generalized osteoporosis and irregular cortical absorption in the long bones. In places, they were so weakened that infractions had occurred as at the lower ends of the tibiae (Fig. 4).

The outstanding feature of this latter type of bone change, as far as the roentgen picture is concerned, is generalized osteoporosis, irregular cortical absorption and softening, with or without compression of the spine and fractures in the long bones. It has to be differentiated from certain other diseases which at times produce similar changes and with which it might be confused.

Neuroblastoma with generalized miliary metastases may simulate rather closely the more advanced changes of leukemia. In both diseases, the films of the skull may show a diffuse granular mottling and in both diseases the cranial sutures may be separated as the result of increased intracranial pressure. It is our feeling that in some instances differentiation would be impossible from the skull films alone.

The pelvis and spine may also give much the same roentgen picture in the two dis-

FIG. 6. The spine of a boy aged six years with aleukemic lymphoid leukemia. Note the extreme softening and compression of the bodies of the vertebrae.

* We are indebted to Dr. Phillip Sylvester for the privilege of including this case in our report.

eases. The bones of the extremities should, however, furnish the information necessary to make a differentiation. It is important that the entire extremities be examined, including the phalanges.

In neuroblastoma, one can by careful study usually demonstrate in some areas small punctate lesions a millimeter or less in diameter which are individual areas of absorption around miliary metastases. These tend to become confluent, however, and are then not well defined.

One of the most important points in the differentiation is found in the distal bones of the extremities. The metastases of neuroblastoma involve particularly the proximal ends of the large bones as the humeri and femora, and much less, if at all, the bones distal to the knees and elbows.

In the cases of leukemia we have seen, however, the forearms, legs and even the phalanges were involved to at least an equal degree, as shown in Figure 5.

Another disease, rare in children, that may cause cortical absorption, osteoporosis and softening, and has to be considered in the differential diagnosis is hyperparathyroidism. The areas of cystic degeneration and giant cell tumors (brown tumors), described as typical in von Recklinghausen's disease, may not be present in the bones of children. In some cases the chief feature as far as the bones are concerned is a generalized decalcification, and in such cases it seems likely that differentiation will rest on studies of mineral metabolism, especially calcium of the blood and its excretion.

No real difficulty should be encountered in recognizing the difference in the roentgen as well as the clinical and hematological pictures between leukemia and erythroblastic anemia. The bones in erythroblastic anemia[1] may be very porous as the result of marked hyperplasia of the marrow substances, with thinning of the cortex of the long bones, but we do not see the diffuse invasion and infiltration of the dense parts as in leukemia. A typical feature of erythroblastic anemia is the thickening of the cranial vault. What is said of erythroblastic anemia also applies to congenital hemolytic icterus and sickle cell anemia although the changes in the later two conditions are seldom as marked as in erythroblastic anemia.

SUMMARY

The bones of 43 children with leukemia were studied roentgenographically.

In 70 per cent of the patients, there was a narrow zone of diminished density proximal to the metaphyses of the long bones. There was generalized osteoporosis in two patients and slight periosteal elevation in two others.

These changes were discussed from the diagnostic standpoint.

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DISCUSSION

Dr. Ralph S. Bromer, Philadelphia. This study of the bone changes of leukemia in children is of importance and value, equal to that of the study of the changes in lead poisoning and other contributions which Dr. Vogt has presented before this Society. As in lead poison-

ing the changes in leukemia are most pronounced in the endochondral areas of bone growth. The other portions of the bones are affected of course, but it seems from the lantern slides just shown that the earlier changes take place at the ends of the diaphyses. In the case of lead poisoning Dr. Vogt added another cause for the increase in width and density of the zone of temporary calcification. In leukemia, he adds another cause for the occurrence of a zone of rarefaction on the shaft side of the zone of temporary calcification, resembling that of infantile scurvy. This zone is no longer to be regarded as a pathognomonic sign of scurvy.

The second slide which was shown is apparently an early stage, earlier than the first slide in which two dense zones with an intervening zone of rarefaction were visible. It occurred to me, and I would like to ask Dr. Baty, whether this patient had any remissions of the leukemic process and whether he regards the formation of this second zone as the result of an exacerbation of the leukemic process after a remission.

Cases have been reported, one by Smith, of the occurrence of arthritis with leukemia. In talking this over with Dr. Vogt, he suggested that possibly the pain and swelling about the joints were due to changes in the bones themselves, rather than to primary arthritic change in the joints. I believe several cases in the series here reported had arthritic symptoms and in the case reported by Smith the patient was at first regarded as a case of articular rheumatism.

In osteosclerotic conditions, such as Albers-Schönberg's disease, blood changes resembling those of leukemia have been reported. Schilling has called this non-leukemic myelosis. Dr. Baty explained the essential difference between the two conditions to me before the meeting and I am going to ask him to tell us in his closing discussion just why in the one case an osteosclerotic change is found and in true leukemia changes such as have been described occur.

I want to emphasize again how important this contribution is. I have no recollection of any paper on the roentgen appearance of the bones of children in leukemia having been read in the last twelve years before the Society.

Dr. Baty (closing). In reference to the first roentgenograms shown, the child had had exacerbations and I think very likely your explanation is the correct one for the dense line above the line of diminished density. During the first few months of her illness she was thought to have acute rheumatic fever.

My only explanation for the difference in the bone changes and blood changes in the two types of conditions, osteosclerosis and osteoporosis, is that in osteosclerosis, marble bones, the bone changes are primary. That is, the osteosclerotic changes gradually crowd out the bone marrow, in some patients resulting in secondary blood changes. There may be a severe anemia with an aplastic type of blood picture resembling the blood picture of aleukemic leukemia. On the other hand, in aleukemic leukemia with osteoporosis, the primary changes are in the bone marrow. There is leukemic infiltration of the marrow with erosion of bone by rapidly growing, infiltrating masses of leukemic cells.

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# AN EVALUATION OF INJURY AND FAULTY MECHANICS IN THE DEVELOPMENT OF HYPERTROPHIC ARTHRITIS*

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ROENTGEN changes around the joints of persons beyond middle life are very commonly observed in routine examinations of these areas. The roentgenologist in most instances finds it difficult to decide whether these changes are due to hypertrophic arthritis, to advancing age, or faulty mechanics.

Formerly these changes were deemed to be definite evidence of hypertrophic arthritis, although in many instances there were no symptoms to support this diagnosis. In the light of studies on the changing anatomic picture seen in joints with advancing age, it is difficult to justify the diagnosis of arthritis in many of these cases. In other cases either direct trauma, or indirect trauma from faulty joint mechanics, may produce bone reactive changes about the joints which simulate arthritis.

In this study we are attempting to determine the effect on the neighboring joints of trauma sufficient to produce fracture of the bone. We selected cases in which the fracture did not involve the joint itself so as to rule out callus formation as a complicating factor. The effect of faulty joint mechanics on the production of reactive changes about the joints will also be considered.

The rôle of trauma in the production of hypertrophic arthritis has engaged the attention of a number of investigators. Many attempts have been made to produce hypertrophic arthritis by traumatizing joints of experimental animals. These attempts have met with varying degrees of success. Key[10] removed pieces of cartilage from the joints of rabbits and noted the changes at intervals. In some instances the defect healed smoothly and in others a deep defect remained. In most instances there were hyperplastic changes around the knee joint, but they were not always in close proximity to the operative defect. In some cases there were also degenerative phenomena such as softening, roughening, and even disappearance of the articular cartilage over the weight-bearing surfaces. He was neither able to determine the nature of the stimulus to new bone production nor the cause of the secondary changes such as softening and erosion of the cartilage. The same author,[11] in another set of experiments, produced knock knee in young rabbits by forcible bending of the knees at weekly intervals. In some of these rabbits hypertrophic arthritis was found to be present after reaching adult life but this was probably produced by disorganization of the joint accompanied by cartilaginous and bone injury.

Previous to Key's experiments, von Sury[14] had attempted to produce arthritis by repeated forcible manipulations and by daily percussion of the knee joints of guinea pigs over a period of months. This produced loosening and degeneration of the cartilage with areas of abnormal calcification. He interpreted these changes as the result of a true hypertrophic arthritis.

Bennett and Bauer[2] studied the joint changes resulting from surgical defects in the articular cartilage and in some instances cartilage and bone. They were able to produce intra-articular changes similar to those seen in hypertrophic arthritis in every joint in which the patella became permanently displaced following the displacement at operation. These changes did not occur in any joint where the patella remained in its normal position. This

* Read at the Thirty-fifth Annual Meeting, American Roentgen Ray Society, Pittsburgh, Pa., Sept. 25–28, 1934.

FIG. 1. Showing excessive hypertrophic spurs on side of vertebrae where impingement occurs from scoliosis.

would seem to indicate that the creation of defects in the articular cartilage alone is not sufficient to produce arthritic-like changes in the joint, but that in addition it is necessary to alter the mechanics of the joint. Pieces of cartilage and bone excised and left as loose bodies did not produce any significant joint changes.

Fisher[6] does not believe that hypertrophic arthritis is a disease entity but that the joint changes represent the physiological and pathological changes that occur when the joint is subjected to prolonged or oft-repeated injury but of moderate intensity. He does not believe that a single injury is likely to produce hypertrophic arthritis. There are certain occupations in which some joints are subjected to undue strain. These joints may in time develop changes identical with those seen in hypertrophic arthritis. Kreuscher[12] described the changes found in the elbow of baseball pitchers who gradually developed this condition. At operation he saw evidence of hypertrophic arthritis. There was cartilaginous destruction combined with osseous proliferation producing partial fixation of the joint. He found small bony osteophytes completely enveloped by cartilage.

Engelhardt[5] believes that circulatory disturbances following injury may produce changes in the cartilage which will be followed by arthritis. He says that in peripheral arteriosclerosis it involves particularly the synovial membranes, which in turn affects the circulation of the cartilage causing necrosis of it. This is followed by arthritic manifestations. He believes that normal cartilage is quite resistant to mechanical injury.

Zollinger[15] states that many cases of injury to the cartilage heal without any evidence of arthritis and that at autopsy

FIG. 2. Localized hypertrophic spurs at site of spinal injury with displacement.

many cases of cartilaginous injury are found without any other evidence of hypertrophic arthritis. He believes that it is not uncommon to find breaks in the cartilage without evidence of arthritis in operative cases. He cites one operator who found intact cartilage in only 33 per cent of his operative cases and another who found only 35 cases of normally intact cartilage in 200 operative cases. This would indicate that cartilage injury may frequently be present without any history of injury. He states that only in those cases where there is a very marked injury to the cartilage with injury to the blood vessels and long-standing disturbance of nutrition does hypertrophic arthritis develop. The same author states that in his series of arthritic cases there were very few cases which did not have involvement of multiple joints. This tends to rule out the influence of injury. He states that the elbow joint is most likely to develop arthritis after injury. Injury to the meniscus of the knee is very likely to lead to the formation of hypertrophic arthritis. Cases of dislocation which are reduced early seldom lead to the formation of arthritis, while those that are reduced late frequently lead to it. Unreduced dislocations usually show evidences of arthritis later.

Fig. 3. Localized hypertrophic spurs in lower cervical spine where movement is greatest. The other vertebrae are negative.

Fig. 4. Extensive hypertrophic changes seen in hip as the result of old slipping of epiphysis with alteration of joint.

Cotton[3] states that it is difficult to believe that trauma ever actually originates hypertrophic arthritis any more than it originates sclerosis of arteries which is in many ways similar.

There seems to be a definite relationship between certain occupations and the development of hypertrophic arthritis. This would tend to support Fisher's[6] statement that oft-repeated mild traumata are the chief etiological factor in hypertrophic ar-

thritis. Baseball pitcher's elbow referred to above is a good example of this. Workers who use compressed air hammers are prone to develop arthritis of the shoulder and arm. Arthritis of the spine is also more common in heavy laborers than in those doing light work. In all these occupational arthritides the changes develop only after a number of years devoted to these occupations.

FIG. 5. Excessive bone production along medial border of upper end of ulna in a baseball pitcher.

In our everyday work we see a great number of cases past middle age who present all the physical changes which characterize hypertrophic arthritis and yet have few or none of the clinical symptoms of it. It has been apparent for a long time that we could not justify a diagnosis of arthritis in all these cases but it was difficult to classify them otherwise. In recent years literature has begun to accumulate on this subject which shows that there is a very definite relationship between age and anatomical joint changes found in resected joints.

A recent report by Keefer, Parker, Myers, and Irwin[8] gives a great deal of detailed information as to the anatomic changes which are found in the knee joint at varying age periods. They found anatomic lesions increasing in frequency with advancing age. The curve showing the number of cases with anatomic lesions rose sharply after twenty years of age to a maximum of over 90 per cent after forty years of age. The anatomic changes were characterized mostly by erosion of the cartilage. These varied from fissures and irregularities of the surface to areas of actual destruction of the cartilage with exposure of the underlying bone. In these areas the bone was dense and eburnated and in some places appeared highly polished.

The areas most commonly affected were those subjected to the greatest movement, strain, weight bearing, and injury during the normal use of the knee joint. The gross anatomic changes were indistinguishable from those of hypertrophic arthritis.

Garvin[7] studied roentgenograms of the spines of 2,090 patients over fifty years of age and found evidence of hypertrophic arthritis in 67 per cent of the men and in 40 per cent of the women. In this group 74 per cent of the men and 61.3 per cent of the women had no complaint referable to arthritis. The fact that so many more men showed anatomic changes than women is suggestive of a traumatic factor, as men engage in much more arduous occupations. The author considers obesity as a traumatic factor also. Smith-Petersen,[13] after a study of microscopic sections of the sacroiliac joints of normal persons and of those with a history of recurring strain of this joint, came to the conclusion that cartilage in traumatic arthritis undergoes the following changes: surface fibrosis, myxomatous degeneration and replacement fibrosis of the matrix. In longstanding cases calcification also occurs. Changes due to age are similar to those of traumatic arthritis

which is consistent since age represents trauma extending over a period of years.

Keefer and Myers[9] have constructed curves illustrating the incidence of anatomic lesions in various joints with advancing age. They have also added curves from other investigators' reports and show that the incidence of these anatomic changes follows a very definite trend in all the joints. The earliest changes are noted around the age of twenty after which there is a sharp rise so that after forty years of age nearly all joints show evidence of anatomic alterations. They believe these gross changes come about as a result of aging of the cartilage or gross trauma. The cartilage becomes split or fibrillated and no longer gives normal protection to the subchondral bone so that it becomes compressed and distorted. If there is complete loss of cartilage over the bone it becomes dense and highly polished. There may be actual fracture of the bony trabeculae with later reparative changes such as new bone formation and cystic degeneration. Marginal exostoses then occur but the authors were not convinced that these are due to new bone production but rather that they are due to flattening of the joint line so that the edge projects over the margin of the bone like a mushroom.

A very important form of trauma which plays a large part in the production of anatomic lesions around many joints is that produced by static deformities and irregularities of the joint surfaces. Static deformities tend to produce an abnormal amount of pressure resulting in wear on certain parts of the joint. The cartilage in those areas is gradually eroded and bone reactions occur as mentioned above.

A familiar example of this is seen in scoliosis of the spine where there is undue pressure on the lateral margins of certain vertebrae with narrowing of the intervertebral discs and marginal lipping often to a rather marked degree. Certain congenital deformities of the vertebrae remove the normal support and allow abnormal pressure effects on the vertebrae. The same type of bone reactions then occur.

In cases of fracture of one of the long bones where union occurs in such position that it disturbs the mechanics of the neighboring joints, it is usual to see traumatic changes in these joints after varying time intervals. This is seen nearly always in the weight-bearing joints such as the ankle and knee when the line of weight bearing is disturbed. In these cases there need not have been any injury whatever to the joint at the time of fracture.

Key[11] has pointed out that Legg-Perthes' disease and slipping of the upper femoral epiphysis are followed by arthritic changes in later life. In the former the femoral head and acetabulum are deformed and in the latter the displaced head of the femur no longer fits the acetabulum. He believes that these deformities acquired in early life are the cause of most of the cases of so-called malum coxae senilis.

A common example of arthritis developing as a result of long-continued strain or pressure is that seen at the first metatarsophalangeal articulation in connection with hallux valgus. Fisher[6] mentions genu valgum as a frequent source of trauma causing disappearance of the external semilunar cartilage and the articular cartilage of the external condyles of the femur and tibia. Lipping around the articular margins then develops. He states also that ankylosis of an adjacent joint is a common cause of hypertrophic arthritis, and shows roentgenograms of a case of extensive arthritis of the knee of a young woman whose hip had been ankylosed since childhood.

When fractures involve the joint it is extremely important to reduce the fragments so that the contours of the articular surface approximate the normal. Arthritis following fracture into the joint occurs with considerable frequency and displacement of the fragments increases this hazard. The so-called bumper fractures, in which there are fractures through one or both condyles of the tibia, are very prone to show evidence of arthritis, especially if there has not been exact reposition of the

fragments. Fractures of the head or neck of the radius may also result in arthritis of the elbow joint. Fractures of the bodies of the vertebrae practically always show evidence of lipping around the injured vertebrae and frequently are united to the adjacent vertebrae by bony bridging.

Various factors enter into the etiology of the arthritis resulting from fracture into the joint. Injury of the cartilage is always present and this combined with bony displacement is usually followed by arthritic changes around the joint. This is especially true of the knee joint when there is displacement of the patella as shown by the work of Keefer, Parker, Myers, and Irwin.[8] There is also the factor of hemorrhage into the joint. It is a well-known fact that extensive arthritis is common in hemophiliacs following mild traumata, with hemorrhages into the joints.[4] When there is displacement of the articular surface the added factor of faulty weight bearing may in itself produce arthritis. The usual formation of callus in the healing of any fracture may also be a complicating factor.

In order to clinically evaluate the effect of a single severe trauma in the production of hypertrophic arthritis we have studied over 600 cases of fracture of the long bones of the lower extremities. We selected out of this series only those cases in which the fracture did not involve the joint surfaces so as to eliminate the complication of disorganization of the joint surfaces. We selected only cases which had been followed roentgenographically for at least eight months, and in which the roentgenograms showed the nearby joints in the first and last examinations. This necessarily reduced very sharply the number of cases available for analysis but we selected 30 cases which fulfilled these qualifications.

Of these cases 16 were males and 14 were females. The age varied from twelve to seventy-one, with an average of forty-four. The occupations of 10 of these patients were listed as automobile factory workers, 13 were housewives, 4 were outside workers, and the remainder office workers. Street automobile accidents were responsible for 12 of these fractures, 10 fell in various ways, the others received their fractures in a varied number of ways. The fractures were evenly divided between the femur and the bones of the lower leg. Eleven were single fractures and 18 were multiple in one or more bones.

In studying the cases we found that the weight-bearing function after reduction of the fragments was excellent in 17 cases, fairly good in 9 cases, and there was bowing in 4 cases. The leg was immobilized for an average of over four months and varied from two months to one year. Nineteen cases had some form of physical therapy and 11 had none. The final result of the fractures was as follows: good union in good position, 18 cases; good union with bowing, 4 cases; non-union, 2 cases; fair degree of union, 5 cases; and amputation, 1 case. The shortest time any case was followed was eight months, the longest time four years, with an average time of twenty months.

In studying the roentgenograms it was found that 29 cases had no evidence of arthritis at the time the fracture occurred and one had a moderate amount of hypertrophic arthritis of the knee. The last films available on these cases showed that there was no accentuation of the arthritis of the knee of the one case which had it previous to the injury. There were slight changes indicating beginning arthritis of the knee in one case of fracture of the upper femur that united strongly but with a definite varus deformity. In the remaining 28 cases there was no evidence of arthritic changes.

These findings, while taken from a small series, would seem to indicate that a single severe trauma does not play much, if any, rôle in the production of hypertrophic arthritis. In the one case showing beginning arthritic changes the fragments had united in such position that the mechanics of the nearby joints were disturbed. This has been shown previously to be a frequent cause of hypertrophic arthritis.

DISCUSSION

A great many experimental and clinical observations have been made in the past few years on the etiology of hypertrophic arthritis. These have tended to change the attitude formerly held in regard to this condition. It is now recognized that some type of trauma is the principal etiological factor in most of these cases. In some cases it appears to be only the normal wear and tear incident to age, although in these cases the question of peripheral arteriosclerosis affecting the circulation, as described by Engelhardt,[5] would have to be considered. In other cases mild trauma continued over a long period of time may produce the changes which are called hypertrophic arthritis. Trauma produced by static deformities and altered mechanics of the joints is a common cause of arthritic changes. Many such cases are seen among old deformities which alter the normal weight-bearing lines.

In a series of extra-articular fractures of the bones of the lower legs which we studied we could find no evidence that a single severe trauma had any influence in producing hypertrophic arthritis. In one case which showed beginning changes about the knee joint the bowing of the femur was sufficient to alter the mechanics of the joint and thus account for the changes which were present. We selected cases of fracture so that we could be sure that sufficient trauma was applied to produce organic injury of surrounding structures. Fractures involving the joint surfaces were eliminated from this study as it is well known that arthritic changes are found in a high percentage of such cases after union occurs. The injury to the joint in this series of cases would probably consist of synovial injury with some cases of hemarthrosis and an occasional cartilaginous injury.

A single injury with hemarthrosis alone would not seem sufficient to produce permanent arthritic changes. Axhausen[1] believes that hemarthrosis cannot be the cause of hypertrophic arthritis, although it can produce changes in the capsule and synovia by organization of the fibrin producing fibrosis and contractures. In hemophila these changes are due to constantly repeated hemorrhages. Cartilaginous injury is usually stated to be followed by arthritic changes but in the experiments of Bennett and Bauer[2] the creation of defects in the joint cartilage did not result in arthritic changes unless the mechanics of the joint was altered. It is difficult to determine the exact rôle that injury to the synovia plays in the etiology of hypertrophic arthritis. Keefer, Parker, Myers, and Irwin,[8] in their study of the anatomic changes found with advancing age, state that the synovial membrane was smooth and glistening in 44 out of 77 cases. In the other cases there were villous projections from the surface. The villous projections were most striking in the patients with the most extensive alterations in joint structure. Engelhardt[5] believes that changes in the synovia are important in the etiology of hypertrophic arthritis because of the blood and nerve supply, but that a clinical diagnosis of this injury can be made early.

It would seem to us that advancing age, with its attendant factors of arteriosclerosis and loss of elasticity and fibrillation of the cartilage, is one of the greatest factors in the production of hypertrophic arthritis. This also includes long-standing wear and tear and minor traumata.

The mechanical theory as to the etiology of hypertrophic arthritis must certainly be given a great deal of consideration. Faulty mechanics locally, as in the case of angulation of a long bone projecting the lines of force in such a way as to produce abnormal pressure on certain parts of the articular surfaces of the nearby joints, may produce quite marked change in the joint. The cartilage shows evidence of gradual erosion in the areas of abnormal pressure and this is followed by eburnation of the bone and marginal lipping. There may be anatomical changes also that produce more general changes, such as extensive scoliosis of the spine, which may affect not only the vertebrae themselves but may produce un-

equal strain on the peripheral joints and affect them also.

## SUMMARY

1. It has been possible to produce hypertrophic arthritis locally by certain types of injury to the joint. This followed much more certainly when the normal articulation of the joint surfaces was interfered with.

2. Long-continued mild traumata are thought to be a common cause of hypertrophic arthritis and certain instances of this are cited.

3. Static strains and altered joint mechanics are also factors in cases where they are present.

4. Anatomic changes in the joint structures show a definite correlation with advancing age.

5. In a group of extra-articular fractures of the long bones of the lower extremities we were unable to find evidence that a single severe trauma has any bearing on the formation of hypertrophic arthritis.

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## DISCUSSION

DR. LESLIE F. WILCOX, Detroit, Mich. I enjoyed the paper read by Dr. Doub, the title of which is "An Evaluation of Injury and Faulty Mechanics in the Development of Hypertrophic Arthritis." I think the important point to settle, if we can, is this: Is there such an entity as traumatic arthritis? A simple definition of arthritis is, if you wish, inflammation of a joint. In our study of pathology, we acquired certain definite ideas of an inflammatory process. The term "inflammation" brings to our mind one important thought, the presence of bacteria or toxins in the tissues and the reaction of the tissue to this enemy.

Now is the healing of a simple fracture of bone with the formation of callus, our conception of an inflammatory process? If so, it might be conceivably called an osteomyelitis. Or is the healing of a wound by so-called first intention our idea of an inflammatory process? If we could have repeated trauma of a tissue in the absence of bacteria or toxins, would the reaction of that tissue be termed inflammation? This is not our belief. Nature does, however,

produce certain changes in these tissues which are repeatedly traumatized and we see these changes as evidence of irritation and repair. We do not believe that repeated trauma to the tissues of a joint will in the absence of toxins produce an inflammation. Thus we must have a definite conception of an arthritis and the resulting characteristic changes in a roentgenogram and we should aim to distinguish these from those irritative changes which occur as a result of injury and faulty mechanics.

The changes seen in the roentgenogram of a wrist in which there has been an old fracture of the scaphoid, or those seen in the scaphoid of the foot in an individual with a flat foot are, we maintain, evidence of irritative changes and cannot be truly called an arthritis. Thus we do not believe that a traumatic arthritis exists. The point which we particularly wish to make here is this: The term arthritis or hypertrophic arthritis is too freely used to cover, as you might say, a multitude of sins. As roentgenologists we should note the changes in the roentgenogram, in the tissues at the joints, and with the other data we should attempt to evaluate these findings and then in only those cases in which we truthfully believe an arthritis is present should this term be used.

Dr. Albertus Cotton, Baltimore, Md. I would like to emphasize the importance of this paper. I am of the belief that hypertrophic arthritis is due altogether or very largely to injury—not sufficient to cause a fracture or dislocation but small repeated injuries extending over a period of years. We have convincing evidence for this belief in the fact that we find this condition only in persons past middle life, and particularly in those whose joints have been subject to repeated injuries, or strain such as spines of the laboring people, and the knees of members of religious orders. I think the sooner we get rid of the idea that hypertrophic arthritis is caused by infection, the better it will be for all concerned.

The internists are constantly looking for foci of infection in these cases of hypertrophic arthritis, but usually don't find them, and when they do, removal of the infection doesn't relieve the condition.

It might be mentioned in passing that the treatment of hypertrophic arthritis is very satisfactory. It does not end in ankylosis except occasionally in malum coxae senile.

It occurs in the hip joint not infrequently in grave-diggers, who use the shovel in such a way as to put a strain on one hip joint, or in drivers of delivery wagons who jump off the wagon, alighting on one foot repeatedly over a period of years.

Principles of treatment are rest, splinting and physiotherapy. When these principles are properly carried out, we get relief of symptoms and functional cures. There is no change in the pathology. The roentgen examination will show the same conditions present as before treatment, but the patient is relieved of his symptoms until he injures or strains his joints.

Now as to the effect of one injury or a severe injury, I believe with Dr. Doub that injury alone does not often cause hypertrophic arthritis. If the patient is within the age period—forty years or older—and if there are hypertrophic changes, so-called age changes, present which had not been causing symptoms, if that patient receives an injury, it will very often light up an arthritis and cause disability for a variable period of time.

This is one of the questions that often comes up in the industrial courts. At the present time in Maryland, the law attempts to evaluate the effect of injury. In cases where patients are disabled for a very long time from an injury to the spine, and it can be demonstrated that they had age changes or a potential hypertrophic arthritis in the spine before the injury, an attempt is made to give them compensation only for the time that would have been required for recovery from a similar injury to a normal spine. That is a recent development. Previously they were all considered compensable for an indefinite time inasmuch as the *disability* was caused by an injury regardless of the fact that they had a potential hypertrophic arthritis before the injury.

The effect of mechanical strain brought out by Dr. Doub is most important. This condition is not infrequently caused by a strain of a joint from faulty mechanics, e.g., hypertrophic arthritis of the knee associated with genu valgum, flat feet, or bowing of the tibia due to rickets or old fracture.

As to the question of traumatic arthritis, there are cases of arthritis following injury to a joint in which the tearing of the ligaments or periosteum around the joint or fracture extending in the joint is followed by callus extending in the joint—these patients have symptoms similar to hypertrophic arthritis and the roent-

genogram will show the new bone formation around the margins of the joint similar to the exostoses seen in the roentgenogram of that type of arthritis.

I want to emphasize again the importance of this paper and to congratulate Dr. Doub upon. it.

DR. DOUB (closing). I wish to thank those who have discussed this paper. I do not like the term "arthritis" when applied to these hypertrophic changes. Several years ago, in looking up the effects of trauma on the etiology of arthritis, I said at that time that I believed it should not be called arthritis, but that it should be called bone reaction following trauma. It seems to me that as time goes on I am getting more and more wary of making a diagnosis of hypertrophic arthritis on every case that I see. I call it marginal lipping or age changes or some such term, because the word "arthritis" itself denotes to the popular mind a generalized disease with inflammatory reaction and a general crippling mechanism which is not present in hypertrophic arthritis.

In a case, such as Dr. Cotton mentioned, of a patient who has hypertrophic arthritis or these reactive changes and who receives an injury, the convalescence may be very much prolonged. However, unless there has been organic injury from the trauma, the joints usually return to normal within possibly six months. Sometimes they claim the effects run as long as a year. The average is closer to six months. Many of these cases draw compensation for years. I know some that have drawn compensation for as long as six or eight years, and in some instances they have been able to reopen the case even after that time, so that it practically amounts to a life pension.

Vol. 34, No. 3

# ROENTGEN DIAGNOSIS OF FRACTURES OF THE BASE OF THE SKULL*

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THE application of roentgen rays to medicine started with the study of the osseous system in the living human body. This field of modern roentgenology was intensively cultivated with utilization of every possibility offered for detailed research and yielded to science a rich harvest of important discoveries. Very soon, however, various obstacles became apparent, especially in the field of diagnosis of cranial injuries. During the last few years, however, a new period of progress in roentgenology has been inaugurated by the successful work of Schüller, Mayer, Stenvers, and many other roentgenologists and surgeons.

With regard to diagnosis of cranial fractures, and more particularly of those of the base of the skull, extraordinary results have been obtained quite recently and in a relatively short time.

In Reinberg's book on Roentgen Diagnosis of Diseases of the Bones and Joints (1929) the reader will still find such remarks as:

> Viewing the immense difficulties which surround and fetter our endeavor towards diagnosis of cranial fractures by roentgen-ray examination, we recognize that most principally and fundamentally, we need exact methodical procedure. But to our great chagrin, the examination of fractures and fissures in the skull presents itself particularly as one of the weakest spots of roentgen-ray examination. In practical competition, this kind of diagnosis has no value and no hope. Surgical examination alone deserves to be considered as dominant and decisive.

Consent to this verdict of full condemnation has nowadays become impossible. Reinberg himself would certainly not now adhere to this severe dictum.

The cranium is a very complicated piece of plastic construction. It consists of numerous bones, mostly symmetrically paired; unpaired bones are in the minority. Generally they are joined together by sutures, varying in form as well as in combination. The top of the skull, the vertex or vault, has a special character, it is peculiar in form and in substance. It is similar to a dome or a cupola. This "box of the human brain" consists of bones which are thinner than the bones of the base of the skull, but their union in the form of a vault strengthens the whole complex and heightens its resistance against injury coming from the outside. The bones of the base of the skull, however, seem to be stronger, as they are more massive. Their protection, too, seems to be better, as they are walled in by muscles. Nevertheless, their armament does not make them entirely safe. In fact, the bones of the base offer many a vulnerable spot. This may sound strange, but it can be easily explained by the numerous foramina which occur in the lower bones of the skull. In addition, the material of this brittle bridgework, the bone substance, is less homogeneous and less elastic, less fit for absorbing shocks and blows. For these reasons, fractures of the base of the skull occur very frequently.

To avoid misconception, one must keep in mind that a distinct boundary between skull top and skull base does not exist. The distinction is simply anatomical convention. There is assumed, as an arbitrary partition, an imaginary nearly horizontal plane, crossing the skull posteriorly at the external protuberances of the occipital bone and frontally at the os frontale of the forehead, a little below the frontal protuberances.

To give a complete conception of the difficulties to be overcome in roentgen diagnosis, attention must be drawn to the

* Translated from the Russian by Joseph Zolin, Ph. D., Johns Hopkins University, Baltimore, Md.

network of lines and shadows which presents itself in each roentgenogram of the skull. All of them originate in impressions on the films made by projection (simultaneously) of different layers of bony substance. The actual location of the shadow-producing bones, as everyone knows, is not like that on the film in one single plane, but separated in space, distributed in different planes which have various angles of inclination to the above-mentioned imaginary partition between top and base. The

FIG. 1. Case 1. Roentgenogram in profile. Some lines of fractures in the squamous portion of the left temporal bone.

superposition of the projections increases the complexity of the pictures. There is no way of overcoming these difficulties, except by improvement of methods, roentgenographic and roentgenoscopic. The reading of roentgenograms must be rendered less difficult. A detailed and simplified procedure will insure success. One must not expect too much from invention of superior technical tools, however helpful improvements of photographic apparatus (e.g. the Potter-Bucky diaphragm) may be.

Modern cranial roentgenography must free itself from the customary limitations by which only two kinds of views were wanted, one in profile and one in frontal aspect. We must now concentrate on detailed localization and explore the various regions of the skull. Accomplishment of this aim will earn a well-deserved reward: due recognition for trustworthiness in our assistance to surgery.

Clinicians will then understand the necessity of being better informed about the resources and possibilities in our specialty and the progressive perfection of our methods. Then they will know that there are cases where more than the two time-honored views may become indispensable. What many a surgeon might not have realized is the fact that for exact examination of fractures in the temporal bone we have as many as twenty-eight methods of procedure, and still more for complicated cases of combined fractures.

As to complicated cases of fractures in the base of the skull, including those of the occipital bone, the summary below shows the eight principal methods of diagnostic procedure.

I. *For the base of the skull:*
   a. Schüller's axial projection.
   b. Inverse axial projection.
   c. Ordinary lateral projection (in profile).

II. *For the temporal bones:*
   a. Schüller-Lange-Sonnenkalb's lateral projection.
   b. Stenvers' posteroanterior projection.
   c. Mayer's axial projection.
   d. Sonnenkalb's tangential projection.
   e. Schüller's sagittal projection.

These eight forms of roentgenographic technique may serve generally as patterns for investigation. In any case, they will enable us to obtain symmetry. There still remains ample opportunity for variation. Each roentgenologist may use his special technique and give welcome evidence of individual expertness in dealing with actual problems. From the eight standard methods the roentgenologist should select whichever is most suitable for his case, according to the following general rules:

1. The axial methods are necessary for basis cranii.

2. Frontal and profile projections offer total aspects of the skull. The lateral projection gives a picture that includes arches and cavities, sella turcica, etc.

3. Schüller's lateral method should be given preference for the temporal bone. Its superiority consists in visualizing the combination of air cells in the coronoid (mastoid) process, the sigmoid sinus, the tegmen tympani et antri, and the entire complex of the pyramid (the petrous portion of the temporal bone).

4. Stenvers' method is indicated for revealing the internal ear, the semicircular canals, the anterior gate, the cochlea, the internal auditory meatus, and the upper region of the pyramid with its apex.

5. Mayer's axial method yields a very distinct view of the tympanic cavity, ossicula

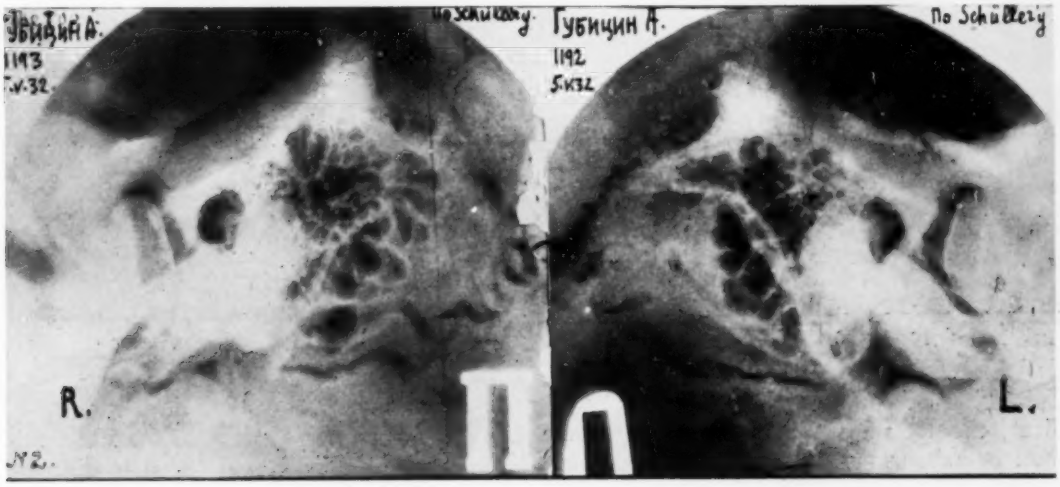


Fig. 2. Case 1. Temporal bone (Schüller's method). Air cells in coronoid process on both sides identical. Line of fracture in temporal bone extending outwards, towards temporomandibular juncture.

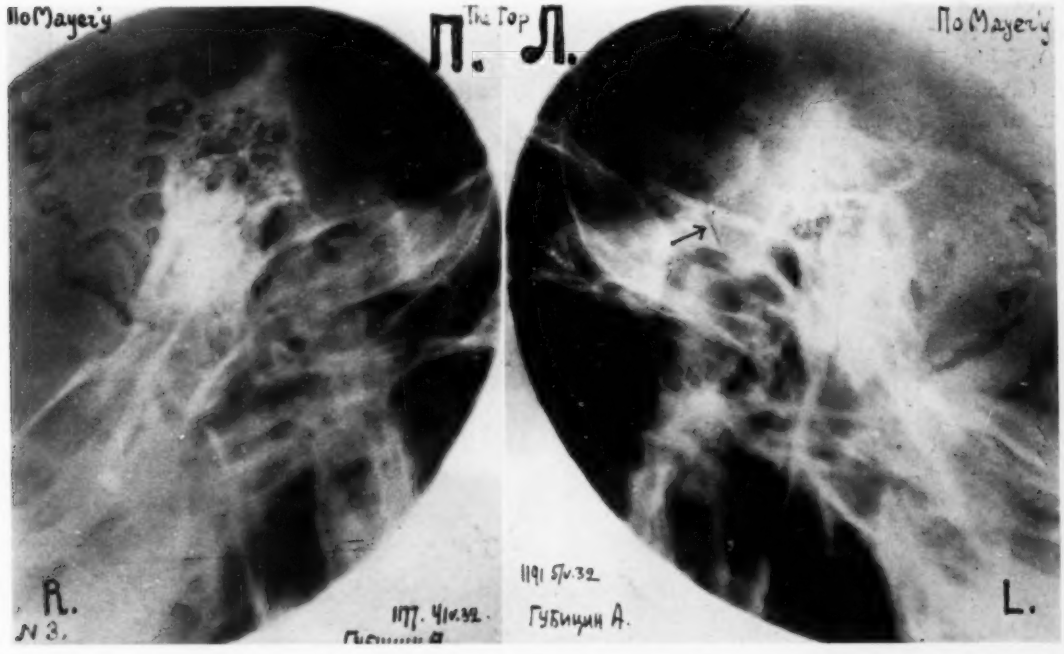


Fig. 3. Case 1. Temporal bone (Mayer's method). View of the line of the fracture in the squamous portion of the left temporal bone and of a transverse fracture in the left pyramid.

FIG. 4. Case 1. Temporal bone (Stenvers' method). View of the line of fracture in the squamous portion of the left temporal bone and of a transverse fracture in the left pyramid.

auditus, the lateral wall, the attic (epitympanum or recessus tympanicus), the opening that leads into the antrum, the antrum tympani with its adjoining cavities (mastoid antrum and air cells), and the external auditory meatus.

6. Schüller's sagittal method projects both pyramids towards the ocular region (the facial area).

7. Occasionally to be recommended is the Altschul method which has won recognition of usefulness for projection of the occipital bone in combination with both temporal bones.

FIG. 5. Case 1. Basis cranii (occipito-submental). Distinct line of fracture in the left pyramid, from foramen jugulare to internal auditory meatus.

As to our chances for making the selection of method correctly and without unnecessary delay, however, we have to face much embarrassment in our practical work of roentgen examination. This problem is fundamentally one of cooperation.

In 1903, when application of roentgen rays in medicine was at a very early stage, Brun collected and published 470 cases of skull injury. He stated that about a third of the cases had a fatal termination. In about 305 cases there was successful treatment. This monograph may still have great value as a medico-historical document, but it is no practical manual of methodical diagnosis of skull fractures, just as it has become valueless for teaching modern therapeutic methods.

Nowadays we are principally interested in the fundamental problem of lowering mortality and restoring health. The surgeon's help is almost continually wanted, especially in larger cities. As a consequence of increased traffic, accidents causing cranial fractures are becoming more numerous. The tremendous toll taken by death through this kind of injuries ought to be lessened by timely operation. Many a patient's life can be saved by undelayed and well directed action, e.g., by trephining or mastoidotomy.

For the purpose of presenting instructive specimens of methodical procedure in

Fig. 6. Case 1. Basis cranii (submento-occipital). Exact location of fracture in the left temporal bone near temporomandibular joint, corresponding with fracture in juncture of temporal bone and sphenoid bone at spina angularis ossis sphenoidalis.

Fig. 7. Case 11. Roentgenogram in profile. No bone in the whole skull shows injury.

roentgenographic and roentgen stereoscopic diagnosis, I wish to report 5 cases which, as a result of repeated sifting, I selected from my file of cases on which I had the opportunity to work during the years 1932 and 1933 in the hospitals of Moscow. I was employed in the Ear, Nose and Throat Hospital (Chief-Surgeon: Professor Svershevsky) and temporarily consultant in the General Surgical Infirmary (General Surgical Director: Professor Spass-Kukotsky). Both of these prominent and progressive scholars have had a considerable share in furthering my researches and I feel obliged to express to them here my indebtedness and sentiments of profound gratitude.

My selection of cases is based on two considerations. Of course, primarily I wished to make a contribution to roentgenology. Here I restricted my material to such cases as were clearly basilar cranial fractures and without manifest outward signs. Thus fractures caused by bullets, swords or other weapons had to be excluded. I limited my selection to accidents caused by falling or by unintentional contact with some major force. From such injuries I selected finally only those which were truly complicated cases. Secondly, I found that restriction to traffic accidents would make this small selection more valuable for economic purposes, to serve as specimens of diagnostic documents in medicolegal cases. It will be noted that the 5 cases are not rare or extraordinary in any

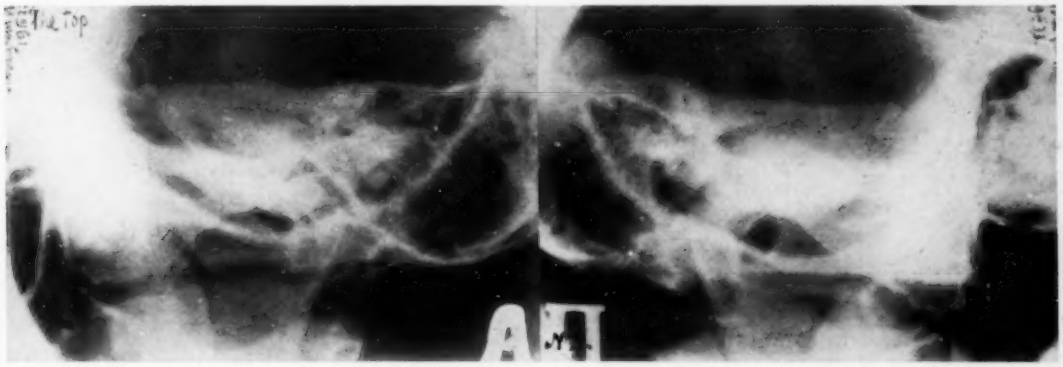

Fig. 8. Case 11. Temporal bone (Stenvers' method). No visible injury in the whole right temporal bone.

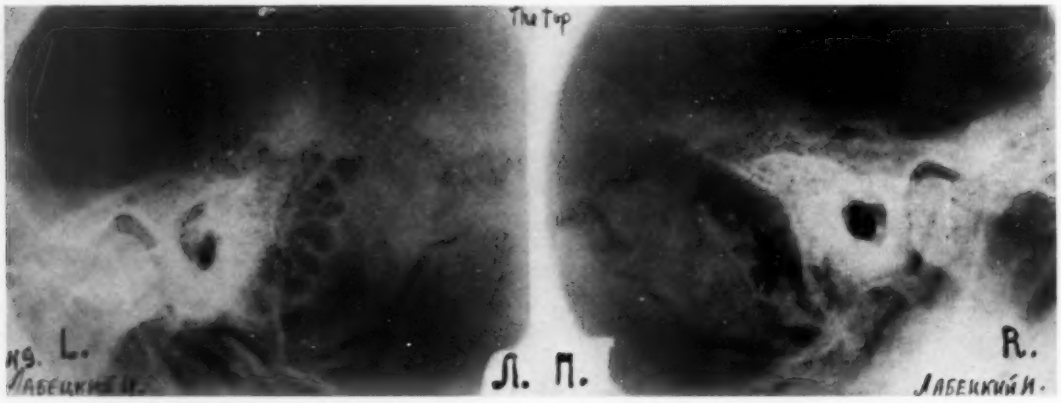


FIG. 9. Case II. Temporal bone (Schüller's method). Remarkable reduction of air cells in right coronoid process. No other change visible.

sense; they are not curiosities. I hope that they will be recognized as patterns of modern methodical procedure illustrating the way to success in diagnostic work, to exact and definite localization. Thus they will be useful for instruction of the roentgenologist, the surgeon and the student of economic and medicolegal problems.

Accurate localization of skull fractures is an achievement hitherto rarely accomplished. In a list published in 1927 by Troell and Holmström, out of 175 cases only 7 are finally claimed as basilar cranial. In one of these cases it is admitted that the roentgen examination did not disclose the exact character of the fracture. What is most principally needed, in any kind of roentgen publication about basilar fractures of the skull, is strict proof that such characterization is accurate and established solely upon roentgen examination.

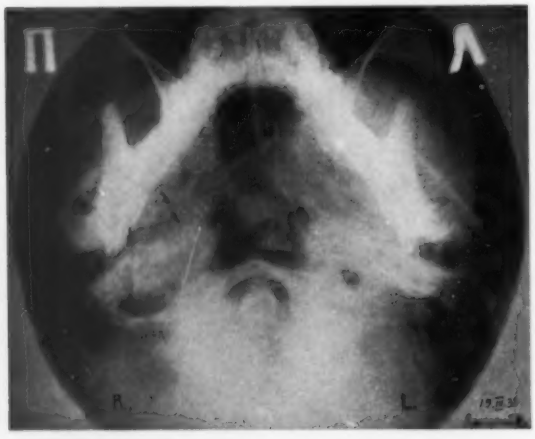


FIG. 10. Case II. Basis cranii (Schüller's axial method). Transverse fracture of right pyramid. Line of fissure from foramen jugulare to foramen lacerum, then forward to central cranial cavity.

Surgical evidence is sometimes divergent from that found by the roentgenologist. The latter bases his verdict on a permanent record, therefore, interpretation can be made by many persons and repeatedly. Surgical diagnosis, however, is limited in this respect. Definite location of the site of a fracture is indispensable for finding its direction, which is most important for therapeutic procedure.

With regard to their characteristic direction, the fractures of the skull are generally divided into longitudinal and transverse. In cases where the temporal bone is involved, the longitudinal fractures generally strike the external auditory meatus, the tympanic cavity, and the middle ear, with 16 per cent of the canalis facialis. It is very rarely that the tympanic membrane remains uninjured. In transverse fractures, on the other hand, the tympanic membrane is left almost intact. But there occurs destruction of the vestibular apparatus. This commonly causes total deafness. In 50 per cent of the cases, paralysis of the nervus facialis will be manifest.

A longitudinal fracture presents itself as a fissure in the anterior or in the posterior cavity of the skull. For an injury in

the anterior cavity one may presume as cause a forceful blow or violent impact upon the cribriform layers of the ethmoid bone. According to clinical experience, such an injury is always followed by hemorrhage from the nose.

A few words may be permitted here about the process of healing. With regard to the vertex and such solid bones as the petrous portion of the temporal bone a great deal of controversy has occurred. Ulrich says that fractures involving the squamous portion and the middle ear always heal excellently, for the fissure very soon becomes cemented with solid osseous substance. Others voice the opposite opinion, saying that such a success will be only temporary for the reason that the bony tissue, in a short time, will undergo a gradual disintegration and finally the fissure will show an increased width. Such disagreeable consequences will persist for the rest of the patient's life. Schüller and Mayer have found that the healing of fractures of the pyramid takes place very slowly, whereas Stenvers states that the normal appearance is restored very quickly.

Fig. 11. Case II. Projection of both pyramids (Schüller's method). Fracture in right temporal bone.

Fig. 12. Case III. Roentgenogram in profile. No injuries visible.

As confirmation for his general statement, he mentions cases of thorough-going transverse cranial fractures of the pyramid (brought about by tremendous blows) as being healed within twenty-four days. Our own personal experience forms a contrast to the optimistic opinion of Stenvers. The case of our patients was similar. But the healing of a transversely fractured pyramid required ten months and was by no means perfect. The cementing of the fissure showed several interstices. A furrow in the squamous portion of the temporal bone had disintegrated and developed into a typical diastasis. There was not only no healing, but, on the contrary, undeniable deterioration. With another patient, we saw defects in ossification of cemented tissue still present fifteen years after a lesion of the vertex. Thus, there is no certainty in foretelling results.

I hope the cases cited below will serve for the purpose of instruction, because they are typical cases and examples of methodical procedure and accuracy of final statement.

### REPORT OF CASES

Case I. Patient G., lathe worker, aged forty-one. Injury incurred on March 11, 1932. He was struck by an automobile and thrown to the stone pavement. Consciousness immediately lost. When he was picked up a small wound at

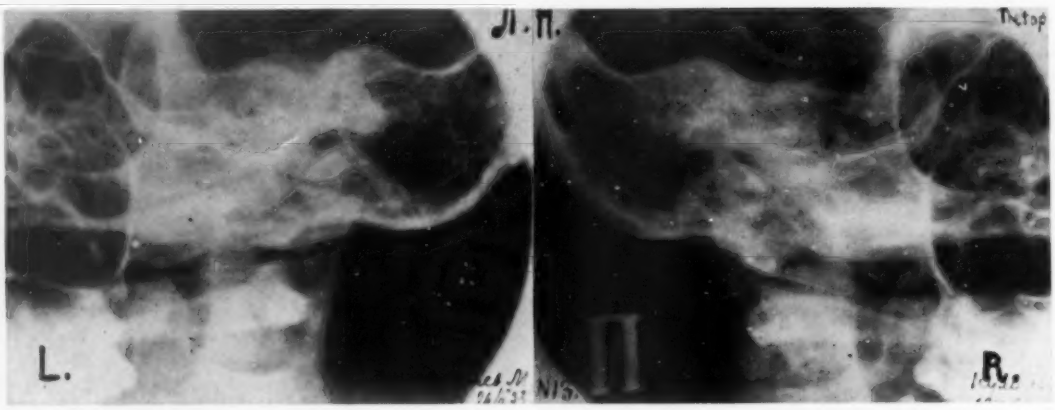


FIG. 13. Case III. Temporal bone (Stenvers' method). Reduction of air cells in the right temporal bone. No other change or abnormality visible.

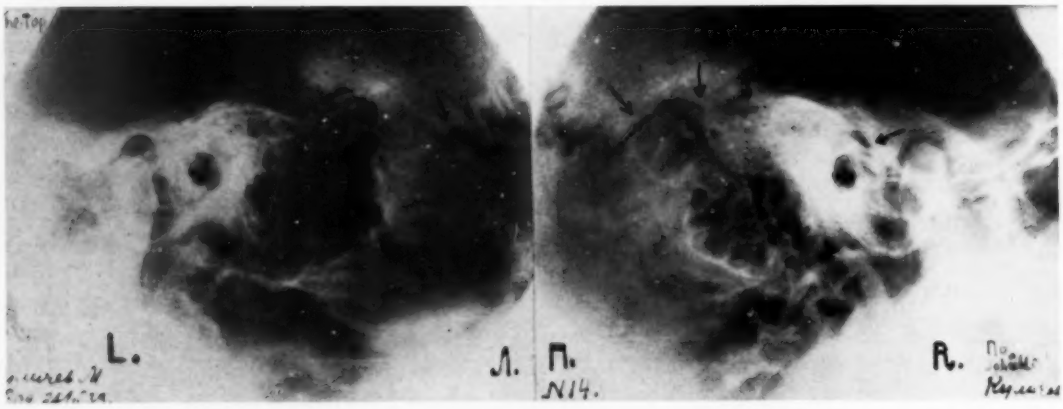


FIG. 14. Case III. Temporal bone (Schüller's method). Remarkable reduction of air cells in right temporal-bone. Line of fracture crossing antrum mastoideum to external auditory meatus. Reduced air cells (everywhere) on the right side.

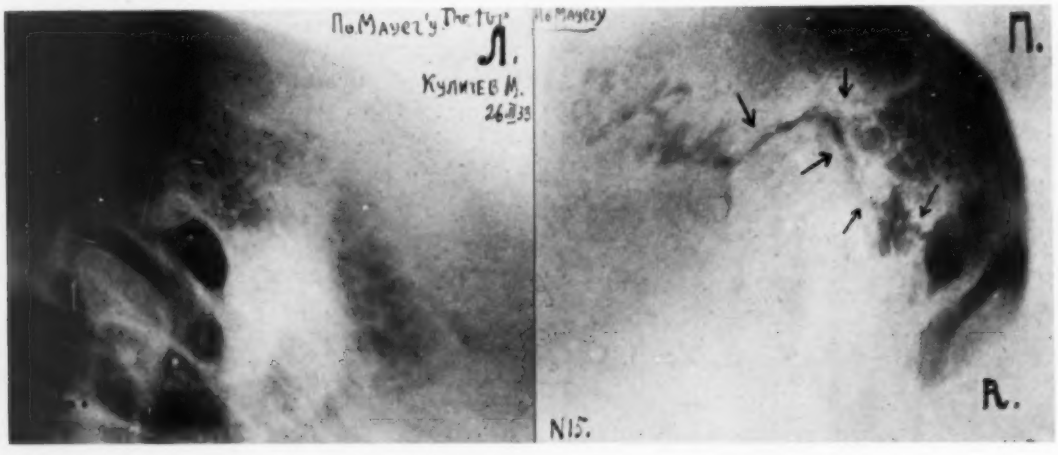


FIG. 15. Case III. Temporal bone (Mayer's method). Good view of line of fracture extending from lambdoid suture through antrum mastoideum to external meatus.

Fig. 16. Case iv. Roentgenogram in profile. No visible injury.

his left ear was visible. He awoke from his coma after twenty-four hours. Complained of violent pain at the site of the trauma. The severity of his headache subsided after half an hour. While he was being treated he had a fainting spell which lasted two or three minutes. Vomiting followed, soon succeeded by hemorrhage from the nose. The left facial nerve appeared paralyzed; noticeable loss of hearing in the left ear; signs of slight paralysis in the left hand. Successful treatment; health completely restored.

*Status before Roentgen Examination.* Paralysis of the left facial nerve; subsidence of sensibility, complete in the first and second branch of the left trigeminal nerve, partial in its third branch; paresis in $C_1$, $C_2$, $C_3$ of the spinal cord. Vision: right eye, −1.0; left eye, −0.5. Hyperemia in the left auditory canal. Peripheral rupture of membrana tympani in the upper posterior quadrant.

*Roentgen Examination.* (1) Roentgenogram in profile (Fig. 1) showed splintered fracture of the squamous portion of the left temporal bone. (2) Schüller's lateral projection of the temporal bone (Fig. 2) confirms the above finding and adds a second finding—a definite demonstration of a second fracture on the left near the junction of the condyle with the mandible. (3) Mayer's axial projection (Fig. 3) confirms the two previous findings but adds nothing. (4) Stenvers' posteroanterior projection (Fig. 4) confirms fracture in the squamous portion, but is not as clearly visible. It is only a faint trace doubtfully suggesting a possible fracture in the left pyramid. It adds a third finding—that of a third transverse fracture in the pyramid, crossing the internal auditory meatus. (5) The inverse axial projection for the base of the skull (Fig. 5) gives confirmation with exact and definite demonstration of the fracture in the left pyramid. Its path runs from the foramen jugulare sinistrum, and forks into two branches, the first section of which is the above-disclosed (finding 2, Figs. 2 and 3) fissure in the temporomandibular articulation. (6) Schüller's sagittal projection (Fig. 6) confirms the foregoing findings and shows the exact site of the last-men-

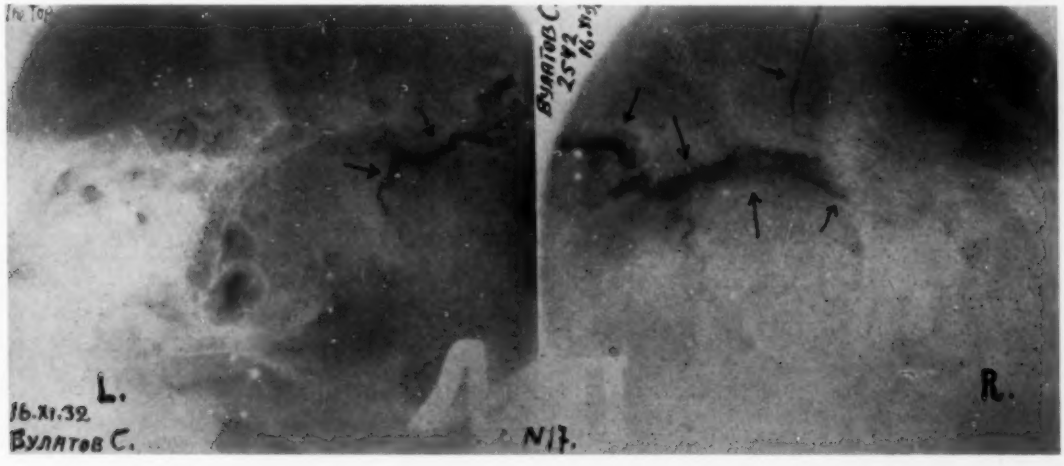


Fig. 17. Case iv. Temporal bone (Schüller's method). Right side: Diastasis of lambdoid suture; wide fissure starting from this site and extending to the base of the pyramid; disclosure of splintered bones; line of fracture crossing antrum mastoideum and turning towards external auditory meatus; additional disclosure of a fissure directed vertically upwards and extending into the squamous portion of the temporal bone. Left side: Diastasis of the lambdoid suture and of a portion of the occipito-mastoid suture.

FIG. 18. Case IV. The occipital bone and the temporal bones (Altschul's method). Remarkable diastasis of sutures down on the right side. Good view of bony splinters in the region of the first-mentioned fracture on the right.

tioned fracture and its forked path (entirely); its first section the fissure in the temporal articulation, as well as its second section at the junction of temporal bone and sphenoid bone going towards the spina angularis ossis sphenoidalis.

Final roentgen diagnosis gave full and definite evidence of a complicated injury, namely fissures of two types, two longitudinal fractures and one transverse fracture.

CASE II. Patient L., waiter, aged forty. Accident occurred on November 10, 1932. He was struck by a broken-off pole of a trolley car and knocked to the ground unconscious. He regained consciousness after several hours. Symptoms of internal injuries; vomiting and profuse bleeding from the right nostril.

*Status immediately before and during Roentgen Examination.* Paralysis of nervus facialis dexter; loss of hearing in the right ear; loss of taste on the right side of the tongue; dryness of the right eye. Surgical examination had not revealed any difference from normal appearance concerning tympanum and tympanic membrane.

*Roentgen Examination* (requested on account of suspected fracture of pyramid). (1) Roentgenogram in profile (Fig. 7): No sign of injury to the skull. (2) Stenvers' method (Fig. 8): No positive finding possible. (3) Schüller's method (Fig. 9): Existence of identical air cells in the coronoid (mastoid) process; no disclosure of a distinct trace of a fracture in the temporal bone. (4) Roentgenogram of the base of the skull (Fig. 10): Positive evidence of a transverse fracture of the right pyramid. The line of the fissure starts from the foramen jugulare dextrum and extends nearly (almost entirely) across the labyrinth. Indication is also given that this fracture extends farther, crossing the central cranial cavity and reaching to the vicinity of the foramen ovale. (5) Schüller's method of projection of both pyramids (Fig. 11): Confirmation of the previously (Fig. 10) disclosed fracture in the right temporal bone; evidence of presumable fractures in the central cranial cavity.

Roentgen diagnosis gave full evidence of a transverse fracture of the right pyramid in combination with a fracture in the central cranial cavity.

CASE III. Patient K., chauffeur. He was knocked down by an automobile and was unconscious for several hours. Consciousness was regained in the G. M. Infirmary; discharged after staying in bed for three days. He returned to his home. He had a hemorrhage from his right ear, a violent headache and he noticed reduction of hearing in his right ear. Profuse serosanguineous discharge followed after hemorrhage had ceased. In this condition he was brought to the Ear, Nose and Throat Hospital.

*Roentgen Examination.* (1) Roentgenogram in profile (Fig. 12): No disclosure of injury to the

FIG. 19. Case V. Roentgenogram in profile. Good view of some venous furrows. Injury to bones of the skull not visible.

skull in general. (2) Stenvers' method (Fig. 13): Gave no evidence of injury in either of the pyramids. Not the slightest trace was found pointing to a possible fracture in the right temporal bone, although such an injury was suspected on account of the symptoms. (3) Schüller's lateral method (Fig. 14) disclosed several pathological peculiarities: (*a*) reduction of air cells in the temporal bone and hematoma; (*b*) separation (diastatic condition) of the lambdoid sutures on the right and the left; (*c*) fracture at the base of the right temporal bone reaching from the lambdoid suture to the right ear, but neither nausea nor vomiting. The trickling of blood lasted several days, then it changed to a permanent seropurulent discharge. The right facial nerve was slightly paralyzed. Hearing in the right ear had disappeared. Otoscopy revealed far in the background of the ear, on the surface, a rather extensive hematoma, apparently hiding some peripheral ruptures. As there was no clinical evidence of fracture, the patient was discharged from the dispensary, but he returned and insisted upon roentgen examination.

*Roentgen Examination.* (1) Roentgenogram

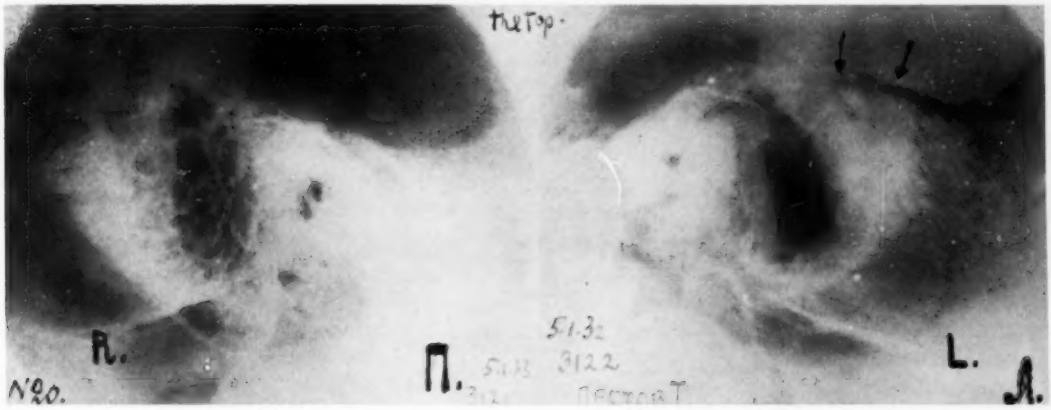


Fig. 20. Case v. Temporal bones (Schüller's method). Good view of an operative defect in the left coronoid process. Diastasis of the left lambdoid suture and disclosure of a fissure extending from this suture to the base of the left pyramid.

auditory meatus. (4) Mayer's axial projection of the temporal bone (Fig. 15): Confirmation of the longitudinal fracture as extending across the mastoid antrum and the tympanic cavity, and disclosure of the destruction of the wall of the exterior auditory meatus.

*Final Diagnosis.* Coexistence of a longitudinal fracture crossing the mastoid antrum and of a fracture of the base of the right temporal bone complicated by mastoiditis.

After three weeks he was dismissed without operative intervention. Condition improved. Later on he returned. Attention was then centered upon the diastatic condition of the lambdoid sutures on both sides. Examination by Altschul's method gave a good demonstration of their existence and peculiar character.

Case iv. Patient G., printer, aged twenty-two. On October 30, 1932, he was flung from an autobus to the pavement. The impact was on the occipital bone. Unconsciousness lasted eight hours. He had hemorrhage from the right ear, but neither nausea nor vomiting. The trickling of blood lasted several days, then it changed to a permanent seropurulent discharge. The right facial nerve was slightly paralyzed. Hearing in the right ear had disappeared. Otoscopy revealed far in the background of the ear, on the surface, a rather extensive hematoma, apparently hiding some peripheral ruptures. As there was no clinical evidence of fracture, the patient was discharged from the dispensary, but he returned and insisted upon roentgen examination.

*Roentgen Examination.* (1) Roentgenogram in profile (Fig. 16) disclosed neither trace of fracture nor signs of pathological peculiarities. (2) Schüller's method (Fig. 17) disclosed (*a*) sharply outlined diastasis of the lambdoid suture on either side; (*b*) sharply outlined diastasis of the parietomastoid suture on the right side; from there a fissure extended towards the external auditory meatus; (*c*) in addition, it disclosed a narrow fissure in the squamous portion of the right temporal bone, the gap turning vertically upwards. (3) Altschul's method for the occipital bone (Fig. 18) offers the possibility to form sound judgment about the diastatic condition of the lambdoid sutures and presents proof of the presence of several splinters in the region of the badly crushed parietomastoid (squamous) suture at the right. The air cells in the right temporal bone are manifestly diminished.

*Final Conclusions.* Diagnosis of diastasis of the lambdoid sutures on both sides and a longitudinal fracture of the right temporal bone

FIG. 21. Case v. Occipital bone (Altschul's method). Diastasis of the left lambdoid suture and view of the above-mentioned fissures.

beginning at the diastasis of the right parietomastoid suture. These findings are the results solely of improved roentgen diagnostic methods (Schüller's and Altschul's). Comparison of roentgenograms later on yielded additional evidence on the existence of some openings in the occipital sutures.

CASE V. Patient P. He fell from a street car on November 14, 1932. Unconsciousness lasted about twenty-four hours. He then had a violent hemorrhage from throat and left ear.

*Roentgen Examination.* Suspicion of fracture of the cranial base caused (in the infirmary) a request for roentgen examination. The patient (for nine days) had felt well, although noticing blood continually trickling from his left ear. Temperature had been almost normal. On November 20 secretion of pus began. It was found coming from a wound in the coronoid process. On December 4 he was treated with a simple trephining of the left coronoid process. After two days he had a temperature of 38.9° C. He was discharged from the infirmary. A month later his treatment was continued in the Ear, Nose and Throat Hospital. There he was sent to the roentgen department to be examined again.

*Second Roentgen Examination.* (1) Skull in profile (Fig. 19) showed no sign of injury. (2) Examination of the temporal bone by Schüller's method (Fig. 20) disclosed the existence of an operative defect in the left coronoid process and of a diastasis in the left lambdoid suture and in the left parietomastoid suture. (3) Altschul's method (Fig. 21) gave confirmation of diastasis of a suture only on the left side.

*Conclusions.* Through roentgen diagnosis it was possible, even after an operative intervention, to locate the fracture of a temporal bone with utmost accuracy.

SUMMARY

Modern methodical roentgen examination has great diagnostic value for disclosure of cranial fractures.

In complicated cases and for guidance for imminent operative intervention the modern methods yield excellent information.

The new method of procedure offers additional possibilities of better supervision of the process of healing in consolidation of fractured bones.

The more extensive and accurate procedure of localized and detailed diagnosis is of utmost importance in facilitating an impartial and incontestable solution of many problems of medicolegal medicine.

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Vol. 34, No. 3

# PROLAPSING LESIONS OF THE GASTRIC MUCOSA*

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INTEREST in the diagnosis of prolapsing lesions of the gastric mucosa was first aroused in this Hospital in 1923. At that time a patient, on whom a preoperative diagnosis of duodenal ulcer had been made, was found at operation to have a large pedunculated papilloma, the pedicle of which was attached just proximal to the pylorus while the tumor itself obstructed almost completely the pyloric exit.

Upon review of the films of this case certain observations were made which rendered it possible to make, subsequently, a preoperative diagnosis of cases of a similar nature. It was soon found, however, that not only pedunculated tumors but also hypertrophic mucous membrane which tended to prolapse through the pylorus caused a similar appearance on the roentgen film. Since 1923 a diagnosis of a prolapsing lesion of the gastric mucosa has been made 99 times. In 1926 Eliason, Pendergrass, and Wright described 4 cases from the University of Pennsylvania and the Philadelphia General Hospitals with surgical confirmation. From 1926 to 1934, sixteen cases were found which either had a prolapsing lesion of the gastric mucosa at operation and which had been examined in this department or were operated upon after that diagnosis had been made in this department. It is with these 16 cases that this paper deals and each one will be discussed in some detail.

CASE 1. J. M., male, aged forty-four, was admitted to the University Hospital complaining of nausea and vomiting. He stated that he was well until three weeks before his admission. At that time, following a heavy meal, he became acutely ill with nausea and vomiting—which symptoms, in association with gaseous eructations and abdominal distention, persisted to the time of his admission. He had had no pain. In the past he had been a painter but he did not use lead and he was a light drinker and smoker. On physical examination he weighed 158 pounds and showed some evidence of recent loss of weight. There was slight tenderness over the gastric area and a tumor was palpable in the right epigastrium. Examination of the gastric contents after a test meal showed free HCl, 0; total acid, 48; and occult blood, 0. The blood Wassermann reaction was negative. The feces were not examined. The hemoglobin was 73 per cent. A clinical diagnosis was not suggested at this time but because of the patient's history he was sent to the department of radiology for study.

Roentgenoscopic examination of the stomach showed a complete six hour gastric residue. There was no dilatation of the stomach; no peristalsis was observed, and the motility was slight. The pylorus was funnel shaped and fixed, suggesting in its appearance a leather bottle stomach. Roentgenographic examination showed a defect in the pyloric region, a constant basal deformity of the duodenal cap, and a central filling defect in the cap. A diagnosis of carcinoma or syphilis was submitted to the surgeon in charge of the patient but an independent diagnosis of a prolapsing gastric lesion was made at the time of the examination by one of the authors (E. P. P.).

At operation the pylorus was found to be indurated, the induration extending completely around the stomach for a distance of 3 inches proximal to the pylorus. A nodular piece of tissue, which later was found to be a pedunculated polyp, was palpated, extending through the pylorus into the duodenum. A gastric resection and Pólya anastomosis were performed. Pathological examination of the resected tissue showed chronic interstitial inflammatory changes at the pyloric end of the stomach and carcinomatous change in the polyp.

The patient improved somewhat following the operation but a year and a half later he again developed signs of pyloric obstruction and died.

*Comment.* In this case, the first in which a prolapsing lesion was present and oper-

* From the Department of Radiology of the Hospital of the University of Pennsylvania, Philadelphia, Pa. All of the cases (with the exception of E. P., No. 8, who was examined in this department and operated upon elsewhere) were collected from the Surgical Service of the Hospital of the University of Pennsylvania.

FIG. 1. Case II. Pedunculated, prolapsing gastric polyps showing a broad pylorus with a broad, irregular, and trabeculated filling defect extending into the base of the duodenal cap.

ated upon after the first report in 1926, the diagnosis of a prolapsing lesion was not submitted although that diagnosis was made by one of the authors of the original and this communication.

CASE II. W. C. K., male, aged forty-four, was admitted to the University Hospital complaining of hematemesis and tarry stools. The black stools were first noticed six months previously when the patient felt below par. Three weeks previously he began to have sharp, mid abdominal pains which were associated with nausea and bloody vomitus. Within this period he lost 7 pounds in weight. His past history was otherwise negative except that he was a heavy smoker and for many years rich foods caused a dull ache in the epigastrium. On physical examination he weighed 134 pounds and had marked tenderness below and to the left of the umbilicus. Analysis of the gastric contents showed free HCl, 0; total acid, 20; and occult blood, 0. The feces were positive for occult blood on many examinations. The hemoglobin was 100 per cent, the red blood count 3,900,000, and the blood Wassermann reaction was negative. A clinical diagnosis of gastric carcinoma was suggested.

Roentgenoscopic examination showed a moderate gastric residue at the end of six hours with hypoperistalsis, hypomotility, and occasional antiperistalsis. A defect, which extended into the duodenal cap, was observed at the pylorus. Roentgenographic examination showed a large pylorus with a broad, irregular, and trabeculated filling defect extending into the base of the duodenum. A diagnosis of carcinoma or a large polyp was made.

A pylorectomy and Pólya anastomosis were performed. On opening the stomach two nodular, ulcerated, polypoid tumors arising from

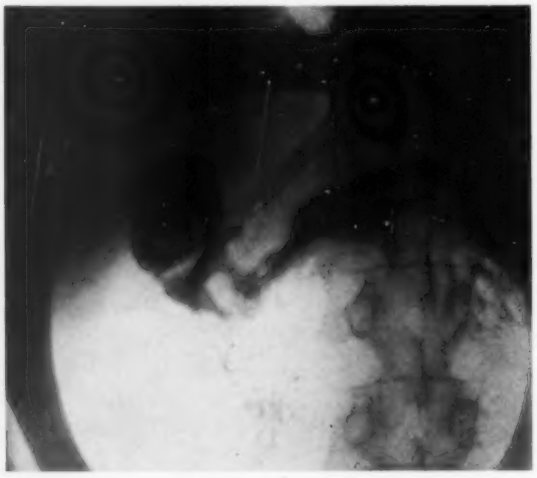

FIG. 2*a*. Case III. Prolapsing hypertrophic gastric mucosa and prepyloric ulcer showing a large, irregular filling defect in the pyloric region and three, well circumscribed, semicircular, negative shadows in the base of the duodenal cap.

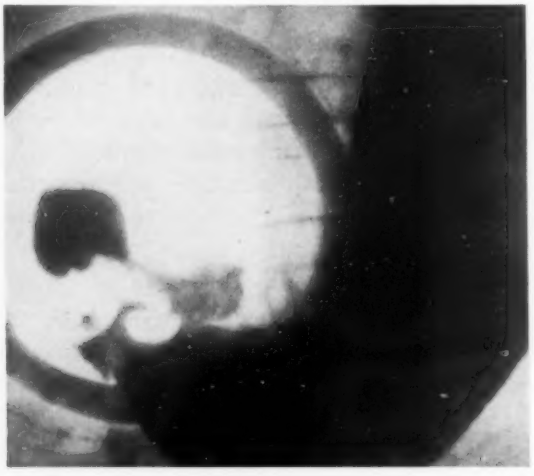

FIG. 2*b*. Case III. Prolapsing hypertrophic gastric mucosa and prepyloric ulcer. The deformity of the pyloric region was due to the prolapsing mucous membrane and the ulcer and the filling defect of the duodenal cap to the prolapsing mucous membrane. The redundant mucous membrane could be expressed into the duodenum at any time.

the posterior gastric wall were found, the smaller of which could be forced through the pyloric ring. A single, white, indurated plaque was also seen on the wall of the pyloric region.

Pathological examination showed the polyps to be benign while the small plaque was malignant.

Following the operation the patient was well until the latter part of 1932 when he had a recurrence of symptoms, four years after his operation.

*Comment.* This, then, was a case in which the correct diagnosis was made. The changes which were observed by the roentgen examination were probably due to the prolapsing polyps and not to the carcinomatous nodule which was a chance surgical finding.

Case III. J. H., male, aged seventy, was admitted to the University Hospital complaining of weakness and gaseous indigestion. He stated that for fifteen years he had suffered from belching, flatulence, and cramps. He had had biliary drainage seven times in the preceding two years without relief. For a short period before his admission his symptoms had increased in severity. He had been a saloon keeper and a heavy drinker until fourteen years before his admission. Physical examination showed only abdominal distention. Gastric analysis was normal and the roentgen examination of the gallbladder was normal. The red blood count was 4,000,000 and the hemoglobin 75 per cent. The blood Wassermann reaction and examination of the feces were not recorded.

Roentgenoscopic examination showed a moderate gastric residue at the end of three and one-half hours and the peristalsis was less than of average intensity. There was a large negative filling defect of the pyloric end of the stomach which was movable and which could be pushed into the duodenum where it caused a deformity of the cap. Roentgenographic examination also showed the large filling defect in the pyloric region and three well-circumscribed, semicircular, negative shadows in the base of the duodenal cap. A diagnosis of prolapsing pedunculated tumors was made and because of the induration of the gastric wall which was found at the roentgenoscopic examination and because of the presence of the defect in the pyloric region these were thought to be malignant.

Fig. 3. Case IV. Redundant pyloric gastric mucosa with polyp formation showing prominent rugae in the prepylorus, a pyloric filling defect which extends into the base of the duodenal cap, and a large semicircular filling defect at the base of the duodenal cap.

A gastrotomy and a posterior gastrojejunostomy were performed. An enormous redundancy of mucous membrane without polyp formation was found in the prepyloric region and a small ulcer was found on the posterior wall near the lesser curvature.

The patient was discharged improved and there is no follow-up record.

Case IV. H. H., female, aged fifty-two, was admitted to the University Hospital complaining of abdominal pain, nausea, and occasional vomiting. She stated that she had had vague indigestion for eight years which was increasing in frequency and severity. These attacks would occur about a half hour after meals and would last for fifteen or thirty minutes. In the preceding ten months she had lost 33 per cent of her weight and in the preceding five months the abdominal pain had been constant and had radiated to the back. On physical examination she weighed 140 pounds and her abdomen was moderately rigid, with tenderness above and to the left of the umbilicus. Examination of the stomach contents showed free HCl, 0 and total acid, 32. The red blood count was 5,200,000; the hemoglobin 98 per cent, and the blood Wassermann reaction negative. The feces were not examined.

FIG. 4. Case VI. Redundant, prolapsing gastric mucosa showing an irregular filling defect of the pylorus and duodenal cap.

Roentgenoscopic examination showed no gastric residue at the end of six hours. The peristalsis was intermittent and hyperactive and the motility was diminished. The pyloric antrum was constantly contracted, with marked hypertrophy of the rugae in this region. The duodenal cap was normal. The roentgenoscopic diagnosis was prolapsing gastric mucosa. Roentgenographic examination showed multiple changeable filling defects and prominent rugae in the prepyloric region and a large semicircular filling defect at the base of the duodenal cap. A diagnosis of lues, hypertrophy of the gastric mucosa, or malignancy was made.

A gastrotomy was performed and redundant mucosa with polyp formation was found in the pyloric region. The polyps were freely movable in this region. Following the operation the patient was discharged improved.

CASE V. S. M., female, aged thirty-seven, was admitted to the University Hospital complaining of pain in the chest and cramps in the abdomen. She stated that for a year she had had abdominal discomfort which came on about one-half hour after meals and lasted for a half hour. This was accompanied by presternal pain, abdominal cramps, nausea, and gaseous eructations. The remaining history was irrelevant. On physical examination the patient was well nourished. She had moderate abdominal tenderness near the umbilicus and a tender, firm, smooth mass was palpable in the left upper quadrant. The stomach contents showed free HCl, 0 to 30 and the total acid 40 to 86. The hemoglobin was 74 per cent and the blood Wassermann reaction was negative. Examination of the feces was not made.

Roentgenoscopic examination showed the stomach to be empty at the end of six hours. Peristalsis and motility were normal and the pylorus and duodenum were normal. Roentgenographic examination showed a slight irregularity and widening of the pylorus with a central filling defect in the base of the duodenal cap. The roentgenologic diagnosis was pedunculated tumor or Harris' membrane. The patient was re-examined and at the roentgenoscopic examination it was observed that the duodenal cap was deformed and rather spastic which suggested an ulcer. However, in view of the first examination and because a central filling defect from a pedunculated tumor could not be excluded a diagnosis of hypertrophic gastric mucosa sometimes prolapsing into the duodenum was made.

A gastrotomy and section of the gastrocolic and hepatic omentum were performed. The mucous membrane at the pyloric end of the stomach was found to be relaxed and partially prolapsed. The cause of the spastic cap was undetermined.

Four years later the patient, except for an incisional ventral hernia, was in excellent condition.

CASE VI. G. B., male, aged forty-six, was admitted to the University Hospital complaining of weakness and abdominal distention which he stated had been present for five years and that four years ago he had had an attack of hematemesis and bloody stools. For two years he had had occasional attacks of epigastric pain which were relieved by eating. Shortly before his admission he again had hematemesis. He had been a heavy smoker and a moderate drinker. On physical examination he weighed 146 pounds; he was well developed, and he appeared to be well nourished. He had slight epigastric tenderness. Gastric analysis showed free HCl, 20 to 45 and total acid, 40 to 60. The

feces were positive for occult blood on one examination. The red blood count was 5,000,000 and the hemoglobin 98 per cent. The blood Wassermann reaction was negative.

Roentgenoscopic examination showed no gastric residue at the end of six hours. No definite defects were seen in the stomach, although the possibility of a pedunculated lesion was suggested at this examination. Peristalsis was normal and there was constant motility. The duodenal cap was constantly deformed. Roentgenographic examination showed an irregular filling defect of the pylorus and the duodenal cap. A diagnosis of pedunculated tumor in the pyloric region or prolapsing hypertrophic mucosa was made.

A pyloroplasty was performed. At operation the pyloric region was negative to direct palpation but duodenitis and adhesions between the gallbladder and the gastrohepatic omentum were observed. The pylorus was opened, however, and it was found that the mucosa was reddened and redundant and could be drawn 1½ inches into the duodenum.

Following this operation the patient was well for two years when he had a recurrence of epigastric pain and vomiting and it was believed that his symptoms were due to pyloric adhesions.

*Comment.* In review of this case it is important to remember that the true pathological condition of the pyloric mucosa was not found until the pylorus was opened and inspected. This lack of palpatory evidence may explain the absence of surgical confirmation in two of the following cases.

Case vii. P. S., female, aged forty-nine, was admitted to the University Hospital complaining of pains all over her body of four months' duration. There were no localizing symptoms. At one time she had a sandy color and considerable menstrual irregularity. She had lost weight from 142 to 124 pounds. On physical examination she was somewhat obese and there was no external evidence of disease. The red blood count was 4,000,000 and the hemoglobin 80 per cent. The urine was negative and the blood Wassermann reaction was negative. The analysis of the gastric contents showed free HCl, 8 to 20 and the total acid, 20 to 60.

A roentgenologic examination of the gallbladder showed non-function. Roentgenoscopic examination of the stomach showed a slight seven hour residue. The peristalsis was of average intensity and the motility was commensurate. The pylorus was normal except in the right oblique position; in this position a filling defect of the pylorus was observed around which the barium mixture was passing. Roentgenographic examination showed some elongation, broadening, and irregularity of the pyloric canal within which was a long central filling defect which extended into the base of the duodenal cap. At this site there were other small circular defects which cannot clearly be seen in the reproductions of the original films. A diagnosis of multiple prolapsing polyps was made.

Fig. 5. Case vii. Pyloric polyps, redundant gastric mucosa, and gallbladder disease with duodenal adhesions, showing elongation and broadening of the pyloric canal, within which is a long central filling defect which extends into the base of the duodenal cap.

At operation a "strawberry" gallbladder with adhesions from the gallbladder to the duodenum was found. The stomach was negative by palpation. The stomach was opened and several small polyps were found attached to very redundant gastric mucosa about one-half inch proximal to the pylorus. The polyps were excised and a pyloroplasty performed.

The patient was discharged still complaining of the pain for which she was originally ad-

FIG. 6. Case VIII. Prolapsing, pedunculated, gastric polyp and duodenal ulcer showing a niche of a penetrating duodenal ulcer and a basal filling defect of the duodenal cap.

mitted. She died about one year later, not improved by the operation.

*Comment.* This, then, was a case in which both duodenal adhesions and prolapsing gastric lesions were present. How much each contributed to the roentgen appearance of the pylorus and the duodenum is impossible to determine, although a diagnosis of a prolapsing lesion was correctly reached. Here again was a case in which palpation of the stomach was negative while pedunculated polyps were found by direct inspection of the mucosal surface.

CASE VIII. E. P., female, aged forty-three, complained of gaseous eructations, distention, and abdominal pain radiating to the right arm. This patient had a roentgen examination in this department but was operated upon in another hospital and the complete clinical data are not available.

Roentgenoscopic examination showed considerable gastric residue at the end of six hours. The stomach was hypotonic and the motility was diminished although there was hyperperistalsis. The pylorus was negative and the duodenal cap filled poorly. Roentgenographic examination showed a constant niche of a penetrating ulcer of the duodenal cap and a filling defect in the cap which was trabeculated. Within the center of the filling defect was a dense shadow which resembled a fleck of a second ulcer. A diagnosis of duodenal ulcer and herniated polyp was made.

At operation a duodenal ulcer and a pedunculated tumor which was prolapsing into the duodenum were found.

*Comment.* In this case the appearance of the cap suggests the presence of multiple polyps but the suggestion of a fleck within the filling defect produced by the polyp makes it necessary to differentiate this filling defect from that which might have been produced by induration from a second duodenal ulcer. This differentiation could be effected by rotating the cap in an attempt to visualize a second ulcer niche.

CASE IX. D. G., female, aged ten, was admitted to the University Hospital complaining of pain in the epigastrium which had recurred

FIG. 7. Case IX. Abnormal mesenteric membrane overlying the first and second portions of the duodenum and an abnormal mesenteric band attached to the gastrohepatic ligament showing multiple, irregular, filling defects in the prepylorus, and multiple, trabeculated, filling defects in the base of the duodenal cap.

at irregular intervals for the preceding nine years. The attacks of pain would last about an hour; they did not radiate; and they were not influenced by eating. The attacks were accompanied by vomiting of ingested material and constipation. The patient had had an appendectomy at the age of six years because of these symptoms but was not relieved. The physical examination was essentially negative except for the appearance of undernourishment. Laboratory studies were negative except for the appearance of acetone in the urine following a severe vomiting attack during her hospitalization.

Roentgenoscopic examination of the stomach at the end of about six hours showed a moderate residue. No defects were observed in the stomach but the pylorus was difficult to fill. The duodenal cap was not seen. Roentgenographic examination showed multiple irregular filling defects in the prepyloric region and pylorus with widening of the pylorus. In the base of the duodenal cap were multiple large trabeculated filling defects. A diagnosis of a prolapsing gastric lesion was made.

At operation an abnormal mesenteric membrane was found overlying the first and second portions of the duodenum and an abnormal mesenteric band extended from the gastrohepatic ligament to the hepatic flexure. These bands were freed from their attachments and the duodenum could be pulled down when it distended in a normal manner. The gallbladder was thickened and surrounded by adhesions which were attached to the gastrohepatic omentum. These were severed.

The patient made an uneventful recovery and there are no follow-up observations.

*Comment.* In this case the age of the patient and the long history would suggest the presence of a congenital rather than an acquired lesion. A mesenteric anomaly would therefore be more likely than a gastric anomaly or acquired gastric lesion. In addition the original diagnosis could not be corroborated by the roentgenoscopic observation.

Case x. T. M., female, aged twenty-seven, was admitted to the University Hospital complaining of pain in the stomach. She had had indigestion and vomiting for seven years and the attacks were characterized by pain in the right lower quadrant and right shoulder, coming on soon after eating and lasting for several minutes. She had lost 10 pounds in weight over a long period. On physical examination she weighed 105 pounds, was short, poorly developed, and poorly nourished. The abdomen was negative. The hemoglobin was 85 per cent. Examination of the gastric contents and feces was not made. The blood Wassermann reaction was not recorded.

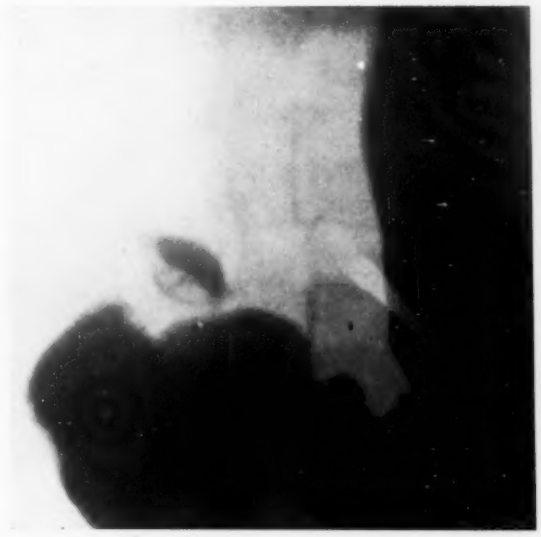

Fig. 8. Case x. Redundant gastrohepatic membrane showing slight irregularity of the outline of the pylorus and a deformity and small filling defect of the base of the duodenal cap.

Roentgenoscopic examination showed considerable gastric residue at the end of six hours, hypoperistalsis, and hypomotility. The pylorus was negative but the duodenal cap was irregular. Roentgenographic examination showed slight irregularity of the outline of the pylorus and a deformity and small filling defect of the base of the duodenal cap. A diagnosis of hypertrophic and prolapsing gastric mucosa or duodenal adhesions was made.

The stomach was opened but no redundancy of the mucous membrane could be found. A redundant gastrohepatic membrane which acted as an adhesion to the gallbladder was observed. Pyloroplasty was performed and the patient discharged in good condition after a normal convalescence.

*Comment.* This case, then, was one in which the diagnosis of a prolapsing lesion of the gastric mucosa was made but not confirmed. The irregularity in outline of

FIG. 9. Case XI. Gallbladder disease with duodenal adhesions showing widening of the pylorus within which is a filling defect and a basal, trabeculated, filling defect of the duodenal cap.

the pylorus with the absence of central filling defects and widening plus the appearance of the duodenal cap in which the narrowest part of the filling defect lies adjacent to the pylorus should suggest a diagnosis other than that of a prolapsing lesion.

CASE XI. E. W., female, aged thirty-two, was admitted to the University Hospital complaining of vomiting and pain in the right upper quadrant. She stated that since the age of twelve she had vomited several times daily and that the vomiting was unrelated to meals. The vomiting was accompanied by nausea, gaseous eructations, and constipation. Fatty foods were not agreeable. For a year she had had a knife-like pain in the right upper quadrant which radiated to the right shoulder. Five years previously a perineal laparotomy had been performed and one year previously she had had an operation for a strangulated bowel. On physical examination she was very obese and quite tender in the right upper quadrant and in both iliac regions. There was no jaundice. Gastric analysis showed free HCl, 0 to 34 and the total acid, 9 to 50. The feces were strongly positive for occult blood on one examination. The red blood count was 4,700,000 and the hemoglobin 85 per cent. The blood Wassermann reaction was negative.

Roentgenoscopic examination showed no residue at the end of five hours. The stomach was hypotonic and peristalsis was diminished with commensurate motility. The pylorus and duodenal cap were negative. Roentgenographic examination showed an irregularity of the prepyloric region possibly due to adhesions, some widening of the pylorus, and a central and basal trabeculated filling defect of the base of the duodenal cap. The gallbladder was normally functioning on the basis of the Graham-Cole test. A diagnosis of prolapsing gastric polyp was made.

A cholecystectomy was performed and at operation many adhesions between the gallbladder and the colon and duodenum were found. The stomach, pylorus, and duodenum were explored by palpation but were found to be negative and were not opened.

The pathological diagnosis was chronic interstitial cholecystitis.

One year after the operation the patient still had pain, although less severe, in the right upper quadrant, and occasional vomiting.

*Comment.* In this case the pylorus was not opened and the mucosa inspected, so the roentgen diagnosis of a prolapsing lesion was not confirmed. The fact, however, that the patient a year later still had symptoms similar to those for which she was originally admitted would indicate that the roentgen diagnosis was not erroneous.

CASE XII. M. K., female, aged forty-eight, was admitted to the University Hospital complaining of pain in the chest, cough, and weakness. She stated that she had had edema of the ankles and dyspnea for several years but was well until four months before her admission. At that time she had a chill which was later followed by cough, weakness, pain in the chest, palpitation, and loss of 15 pounds in weight. On examination she had an obvious anemia, tachycardia, tachypnea, retinal hemorrhages, and a small nodule in the thyroid. The abdomen was negative. Gastric analysis showed free HCl, 0 and total acid, 16 to 24. The feces were negative for evidence of occult blood. The blood Wassermann reaction was negative. The red blood count varied from 1,000,000 to 2,300,000 and the hemoglobin from 17 to 46 per cent. The latter determinations were made after five transfusions had been given. There

was also a persistent leucopenia and there was no response to liver and ventriculin therapy. A clinical diagnosis of aplastic anemia was made.

Roentgen examination showed hypertrophic rugae, a narrow, tubular prepyloric region, and an irregularity of the duodenal cap. A roentgen diagnosis of prolapsing gastric mucosa was made.

A splenectomy was performed. At operation the pylorus and duodenum were palpated and found to be negative. The pylorus, however, was not opened. The patient died on the second postoperative day and an autopsy was refused.

Here again the pylorus was not opened and the mucosa not inspected and so the roentgen diagnosis was not confirmed.

Case xiii. E. M. Y., female, aged fifty-five, was admitted to the University Hospital complaining of intermittent diarrhea. She stated that for the last nine years she had had attacks of diarrhea which occurred every few months and lasted a few days. During the attacks she felt weak and rundown. The stools had never been bloody. On physical examination she was nervous and thin. The abdomen was negative. A record of the laboratory studies was not available.

Roentgenoscopic examination showed a slight six hour gastric residue. Peristalsis and motility were normal except in the right oblique position in which there was hypermotility. Roentgenographic examination showed multiple, irregular filling defects in the duodenal cap. A diagnosis of pedunculated and prolapsing polyps was made.

The stomach was opened at operation and there was no evidence of polyp in the stomach or duodenum. Many dense adhesions were found covering the first and second portions of the duodenum and these were separated.

The patient was discharged in good condition.

Case xiv. F. H. B., female, aged forty-nine, was admitted to the University Hospital complaining of gaseous distention. She stated that for the last five years she had suffered considerably from gaseous distention which occurred at infrequent intervals but which, when it occurred, always came on after meals. Vomiting gave her relief and at times she would vomit undigested food particles eaten five to six hours earlier. In the week preceding her admission the attacks had recurred about twice daily. On examination the patient was well developed and well nourished. There was slight midline abdominal tenderness midway between the xiphoid and the umbilicus. The red blood count was 4,600,000 and the hemoglobin 88 per cent. The blood Wassermann reaction was negative. Examination of the gastric contents and feces was not done.

Roentgenoscopic examination showed almost a complete gastric residue at the end of six hours. The stomach was hypotonic, and the motility was diminished although the peristalsis was very active. A constant defect was observed at the pylorus while the duodenal cap was normal. Roentgenographic examination showed elongation of the pylorus and a hollow appearance in the base of the duodenal cap. A diagnosis of some organic lesion at the pylorus with the appearance strongly suggesting hypertrophic pyloric mucosa tending to prolapse into the duodenum was made.

At operation the patient was found to have a benign hypertrophy of the pyloric muscle and a subtotal gastrectomy and a Pólya anastomosis were performed.

The pathological diagnosis was inflammatory linitis plastica.

The patient died of shock after an operation for intestinal obstruction which occurred three days after the original operation.

*Comment.* In reviewing this case it was thought probable that an erroneous diagnosis would not be made at present. The typical appearance—the elongation of the pylorus and the crescentic indentation of the bulbar base—of hypertrophy of the pyloric muscle would suggest the correct diagnosis. The fact, however, that this case was erroneously diagnosed makes it one to be considered in the differential diagnosis.

Case xv. S. R., male, aged fifty-eight, was admitted to the University Hospital complaining of pain in the epigastrium and in the back on the left side. He stated that for fifteen years he had had epigastric and lumbar pain which would come on about one-half hour after meals and which was relieved by soda and vomiting. Fruits and leafy vegetables aggravated the pain. Vomiting was never spontaneous. Fifteen years ago he had a laparotomy and an appendectomy. The stomach and duodenum were explored but no ulcer was found. This operation afforded the patient no relief. On physical

FIG. 10. Case XV. Duodenal ulcer with adhesions and prepyloric ulcer showing slight deformity of the pylorus and a trabeculated, circular, filling defect of the apex of the duodenal cap within which is a "fleck" of an ulcer crater.

examination of the abdomen there was no tenderness and no rigidity and no organs or masses were palpable. The hemoglobin was 100 per cent. The gastric contents and feces were not examined. The blood Wassermann reaction was not recorded.

Roentgenoscopic examination showed a moderate gastric residue at the end of six hours. There was hypoperistalsis with good motility. The pylorus showed a persistent defect along the greater curvature with a tongue of barium extending from it. The duodenal cap was negative. Roentgenographic examination showed a deformity of the pylorus with a trabeculated circular filling defect of the apex of the duodenal cap within the center of which was a small area of increased density. A diagnosis of prolapsing pedunculated tumor and prolapsing gastric mucosa was made. Malignancy was also considered.

At operation the patient was found to have an ulcer on the superior anterior surface of the duodenum, which was surrounded by dense adhesions, 1 cm. distal to the pylorus, and an ulcer on the lesser curvature of the stomach 2.5 cm. proximal to the pylorus. There was also partial stenosis of the duodenal bulb. The gastric ulcer was excised and the duodenal ulcer was oversewn and a posterior gastrojejunostomy performed.

Pathological examination of the excised gastric ulcer showed it to be ulcerative mucoid carcinoma.

The patient was discharged in good condition but no follow-up notes were recorded.

*Comment.* In this case the filling defect in the duodenal cap was due to the indurated ulcer and adhesions. The filling defect was at the apex of the cap and not at the base where one would expect to find it if a prolapsing lesion were present. Within the defect there was a central fleck, the barium-filled crater of the ulcer.

CASE XVI. N. R., male, aged twenty-nine, was admitted to the University Hospital complaining of pain in the left upper quadrant and belching. He stated that for five years prior to his admission he had had frequent attacks of gaseous eructations which would recur several times daily for several weeks, following which he would have several weeks of freedom from these attacks. For a year and a half prior to his admission he had had attacks of left upper quadrant pain, the attacks being related to meals and the attacks becoming more frequent and severe. He had smoked forty cigarettes a day for the last ten years and had lost 15 pounds in weight in the preceding six weeks. On physical examination he was well developed and nourished and the examination was otherwise essentially negative. Examination of the gastric contents after a test meal showed free HCl, 16 to 58, total acid, 40 to 78, and occult blood, +. The blood Wassermann reaction and the urine were negative. The feces were not examined. The red blood count was 5,000,000 and the hemoglobin 104 per cent. Clinically, a diagnosis was not established but a pyloric or duodenal lesion was suspected.

Roentgenoscopic examination of the stomach at the end of four and a half hours showed no residue. The appearance of the stomach suggested polyposis. There was marked hyperperistalsis and the motility was not commensurate. The duodenal cap was irregular in contour and its appearance suggested hypertrophy of

Fig. 11*a*. Case xvi. Duodenal ulcer, posteroanterior view, showing multiple, irregular filling defects of the prepylorus and pylorus, and a large, trabeculated, filling defect near the apex of the duodenal cap within which is the "fleck" of the ulcer crater.

Fig. 11*b*. Case xvi. Duodenal ulcer, oblique view, showing the spastic incisura which gave the impression of a central filling defect in the posteroanterior view.

the rugae. Roentgenographic examination showed a defect in the pyloric region and a large trabeculated defect in the duodenal cap with a central circular dense area. A diagnosis of prolapsing pyloric polyps and possible duodenal ulcer was made.

At operation a very indurated duodenal ulcer was found on the anterior surface of the cap which had a crater about 1 cm. in diameter. The stomach was opened, explored, and the gastric mucosa found to be considerably hypertrophic but not obstructing or prolapsing into the duodenum. The stomach was closed and a posterior gastrojejunostomy performed. The patient was discharged in good condition and there are no follow-up notes.

*Comment.* In this case the hypertrophic gastric rugae might easily be confused with diffuse polyposis but the diagnosis of a duodenal ulcer and not a prolapsing lesion should have been made. The following points are differential. In this case the fil-

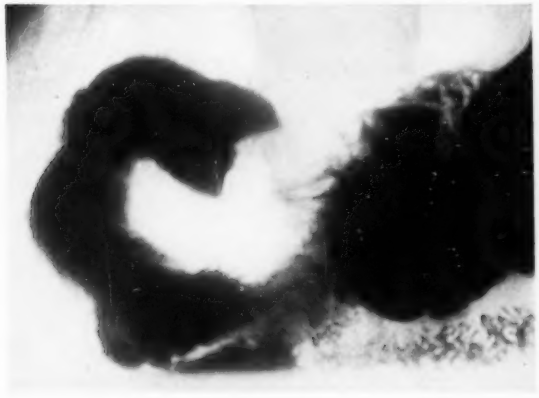

Fig. 11*c*. Case xvi. Duodenal ulcer, posteroanterior view, showing the duodenal cap completely filled which indicates that the apparent filling defect was due to spasm and not to an intrinsic lesion.

Fig. 12. Case xvii. Neoplastic nodule in liver to which the duodenal cap was adherent and which produced a large, circular, filling defect in the duodenal cap.

ling defect in the duodenal cap is not associated with that in the pylorus. It lies in the apex of the cap rather than in the base and the base of the lesion itself lies adjacent to the second portion of the duodenum rather than adjacent to the pylorus. In addition, there is within the filling defect a fleck, the ulcer crater, which is not seen when these duodenal defects are caused by prolapsing gastric lesions.

## DISCUSSION

There is no characteristic clinical syndrome on which to base the diagnosis of prolapsing lesions of the gastric mucosa. The youngest patient with a prolapsing lesion was thirty-seven years old; the oldest seventy, and the remaining 6 were between forty-three and fifty-two. Four patients were males and 4 were females. The most common complaint was that of vague indigestion; vomiting and hematemesis occasionally occurred. The patients tended to be of normal constitution; some were obese. On physical examination there was little to be found except some indefinite abdominal tenderness. The gastric acidity was normal or diminished; there was blood in the stools of those complaining of hematemesis; slight anemia was common, and 7 of the patients had negative blood Wassermann reactions. These symptoms, signs, and laboratory findings, while not in themselves diagnostic, point to the digestive tract as the seat of the patient's disorder. The roentgen examination of these patients therefore plays a rôle of great importance in the diagnosis of these lesions.

It is desirable, then, because of the importance of the roentgen examination, to establish certain diagnostic criteria upon which to base the roentgen diagnosis of these disorders of the stomach and duodenum. The roentgenographic findings which were described by Pendergrass in the previously mentioned paper of Eliason, Pendergrass, and Wright deserve discussion here. In brief, these findings were somewhat as follows:

1. These prolapsing lesions of the gastric mucosa produce a central filling defect in the duodenal cap and there is a thin shadow of bismuth around the defect.

2. The defect is generally not seen in films made in the erect posture.

3. The diagnosis can be overlooked easily in the roentgenoscopic examination.

4. There is no disturbance in the passing of the peristaltic waves.

5. There is always a six hour residue.

6. There is no defect of the stomach in the presence of pedunculated growths which prolapse through the pyloric ring.

7. There is a variable defect of the pyloric region of the stomach when prolapsed mucous membrane extends through the pyloric ring.

These diagnostic criteria should be compared with observations made on these subsequent cases which are presented here. The most striking discrepancy between these later observations and the criteria first enumerated is in that one which deals with the roentgenoscopic examination. In fact, it may now be said that the most certain point in the diagnosis of these obscure lesions is that the presence of a prolapsing lesion of the gastric mucosa suggests itself at the roentgenoscopic examination. It will be noted that in the 7 cases in which there was surgical confirmation of the roentgen diagnosis of a prolapsing lesion this diagnosis was made, or suggested, even in the absence of definite signs such as six hour gastric residue, pyloric defect, or duodenal defect, in 5 cases by roentgenoscopic examination. In one case in which the presence of a prolapsing lesion was proved by operation the lesion was not diagnosed. In the 8 cases, however, in which there was not surgical confirmation of the roentgen diagnosis of a prolapsing lesion this diagnosis was not suggested by roentgenoscopic examination. It appears, therefore, that the diagnosis should rest on the roentgenoscopic findings. The most characteristic finding was that observed in Case III, in which the roentgenoscopic appearance was described as "a large negative filling defect of the

pyloric end of the stomach which was movable and which could be pushed into the duodenum where it formed a deformity of the cap." Such an appearance may be accepted as the essential diagnostic feature of the disorder.

If the films are to be made they should be exposed with the patient in the position in which the duodenal cap is best filled. There was a gastric residue in 5 out of the 8 proved cases. Peristalsis and motility vary considerably from case to case and variations in them are not dependable as secondary corroborative evidence of the existence of these prolapsing lesions.

We know of no reliable criteria for differentiating between prolapsing gastric polyp and prolapsing hypertrophic gastric mucosa. It happens that in this series of 8 proved cases, 7 of which were diagnosed as a prolapsing lesion before operation, the diagnosis of prolapsing polyp was made 5 times and was present at operation in 4 cases and the diagnosis of prolapsing gastric mucosa was made 3 times and was present at operation in 4 cases. Two out of 4 cases of prolapsing polyp and 2 out of 4 cases of prolapsing gastric mucosa showed a filling defect of the pylorus on the films. One case which showed this pyloric defect was found at operation to have both prolapsing polyps and mucosa. The presence or absence of a pyloric filling defect is therefore inconclusive in the differentiation between prolapsing polyps and hypertrophic prolapsing gastric mucosa.

### DIFFERENTIAL DIAGNOSIS

The errors in the diagnosis of prolapsing lesions of the gastric mucosa are not made by calling these lesions other diseases but by calling other diseases these lesions. Congenital mesenteric membranes, redundant normal membranes, inflammatory adhesions, a hypertrophic pyloric muscle, and duodenal and gastric ulcers have been confused with these prolapsing lesions. It is conceivable that gastric carcinoma and retained food particles might also be sources of confusion.

Congenital mesenteric membranes (cf. Case IX) overlying the pylorus and duodenum are likely to produce symptoms long before the age of the greatest incidence of the prolapsing lesions is reached. Roentgenoscopic examination should exclude a prolapsing lesion. The case of redundant gastrohepatic membrane (Case X) falls in the same class. Here again the age of the patient and the failure to make the diagnosis at roentgenoscopic examination are against the diagnosis of the prolapsing lesion. In addition, the duodenal filling defect which was observed on the film was in the apical portion of the cap rather than in the base adjacent to the pylorus. Inflammatory duodenal adhesions (cf. Case XI, and Case XIII) are more confusing because they are likely to be seen at the age at which the prolapsing lesions occur in their greatest frequency. Here again the roentgenoscopic examination must exclude the presence of a prolapsing gastric lesion. Inflammatory duodenal adhesions, while they may produce the appearance of a filling defect in the duodenal cap and irregularities in the outline of the pylorus, are not likely to produce the appearance of filling defects within the pylorus. Hypertrophy of the pyloric muscle (Case XIV) shows characteristic elongation of the pylorus and crescentic indentation of the duodenal cap rather than actual filling defects within the cap. The indurated margin of a duodenal ulcer, with or without spasm (cf. Cases VIII, XV and XVI), is likely to produce a filling defect in the apical portion of the cap with the broadest part of the defect away from the pylorus. Prolapsing gastric lesions produce a filling defect in the basilar portion of the cap adjacent to the pylorus and the broadest part of the defect is closest to the pylorus. The fleck or niche of duodenal ulcer should be found at the roentgenoscopic examination and one or both—the fleck occupying the center of the apical defect—should be observable on the films. Case XVII is presented through the courtesy of Dr. Elwood Downs of Jeanes Hospital. Roentgen ex-

amination of this patient showed a large, constant, central, circular filling defect in the duodenal cap. The patient had a large pelvic mass and ascites and this lesion was thought to be a pedunculated tumor. At autopsy the duodenal cap was found to be adherent to the liver in which, at this site, there was a large firm neoplastic nodule. The filling defect was therefore caused by extrinsic pressure rather than by an intrinsic lesion. In review, then, with regard to the differential diagnosis of these lesions the roentgenoscopic examination should be depended upon either to make or exclude the diagnosis of a prolapsing lesion.

## TREATMENT

The treatment of these patients is almost entirely surgical. Excision of polyps, for symptomatic relief and because the polyps tend to bleed and are sometimes malignant, is the treatment of choice when such lesions are present, while pyloroplasty and posterior gastrojejunostomy have been performed in the presence of prolapsing hypertrophic gastric mucosa. The number of patients operated upon and the follow-up examinations of them have not been sufficiently numerous to justify any conclusions concerning the efficacy of these surgical procedures. When a roentgen diagnosis of a prolapsing lesion has been made and there is sufficient clinical evidence to indicate a laparotomy, the pyloric region should always be opened and inspected as the palpating finger is not in itself competent to rule out a prolapsing lesion (cf. Cases VI and VII). Microscopic examination of resected polyps was performed in only 3 cases. In 2 cases the polyps were benign while in one other the polyp was malignant.

## CONCLUSIONS

Eight cases of prolapsing lesions of the gastric mucosa have been studied in this Hospital since 1926. Seven of these cases were diagnosed correctly preoperatively by roentgen examination while no diagnosis was submitted in one case. Eight cases of a variety of other gastric and duodenal diseases were diagnosed incorrectly as prolapsing lesions. The essential diagnostic feature of these prolapsing lesions was the appearance of "a large negative filling defect of the pyloric end of the stomach which was movable and which could be pushed into the duodenum where it formed a deformity of the cap." The appearance on the roentgenogram of these lesions is suggestive but not characteristic as it is simulated by other conditions. When such a suggestive appearance is observed on the roentgenogram in the presence of a negative roentgenoscopic examination the diagnosis of a prolapsing lesion of the gastric mucosa should be held to be equivocal and the patient re-examined, giving special emphasis to the roentgenoscopic examination. No attempt at distinction between prolapsing hypertrophic gastric mucosa and prolapsing pedunculated polyp should be made roentgenologically but the condition should be diagnosed merely as a prolapsing lesion of the gastric mucosa. The treatment of these lesions is entirely surgical. The diagnosis is of great importance because the lesions tend to ulcerate and bleed, with subsequent secondary anemia. Early recognition and resection of prolapsing polyps is of great importance because they may be malignant. The roentgen examination of these patients, because there is no characteristic clinical syndrome, occupies the place of prime importance in the diagnosis of these obscure lesions.

Vol. 34, No. 3

# DIVERTICULUM OF THE CARDIA OF THE STOMACH

## CASE REPORT

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THAT diverticula of the stomach are rare is shown by Lockwood[7] who found in the literature only about 45 cases up to 1932. The first case was reported by Helmont[2] in 1804. From that time until the advent of the roentgen ray almost no cases were found. Since then occasional cases have been reported, but always as an accidental finding in the gastrointestinal examination.

Diverticulum of the stomach is a circumscribed, more or less rounded, or bag-shaped protrusion from the lumen of the stomach. While they may be located in any part of the stomach, most of them occur at the cardiac end at or near the esophageal opening, and more often posterior than anterior. Keith[6] describes this region of the stomach wall as being weak and predisposing to diverticulum.

They are divided into true and false, congenital and acquired. The acquired may be subdivided into pulsion and traction diverticula.

### ETIOLOGY

Although the number of cases reported is not sufficient to draw definite conclusions we are of a belief that most of the diverticula are acquired. Hurst and Briggs[3] support this by drawing attention to the pressure imposed on the stomach in certain conditions and cite a case in which a diverticulum was found, following four induced labors on account of pernicious vomiting. That the intraventricular pressure may be increased to a very high degree in labor is demonstrated by Miller,[10] who records a case of spontaneous rupture of the stomach in childbirth due to mechanical causes. Under such conditions it can easily be imagined how a pouch might blow out at a point where the wall of the stomach is congenitally weak. The influence of childbirth may be further supported by the fact that diverticulum of the stomach occurs almost twice as often in women as in men. In reviewing the literature we found 43 cases in which the sex was recorded. Of these 28 were women and 15 men. Another argument in favor of the traumatic theory is the lack of diverticula in children; almost none have been reported. Of 42 cases in which the age was reported it was as follows:

| | Cases |
|---|---|
| From 20 to 30 years | 5 |
| From 30 to 40 years | 12 |
| From 40 to 50 years | 13 |
| From 50 to 60 years | 8 |
| From 60 to 70 years | 3 |
| From 70 to 80 years | 1 |

Of course it is possible that diverticula may be congenital and not appear until adult life. But, if this were really true, instances of diverticulum should occasionally be found in children at autopsy.

### DIAGNOSIS

It is very difficult to ascribe any characteristic symptoms to diverticula of the stomach as nearly all the cases had associated pathology, such as ulcer, gastritis or malignancy. There is usually a long history of epigastric distress, pain of a burning, pressing, bursting type, relieved by vomiting, eructation or in some cases by lying on the back; it is not relieved by alkalies or food. A frequent symptom in the uncomplicated cases is tenderness in the left costal margin and this was present in the case we are about to report. So far the diagnosis of diverticula is based entirely on the roentgen findings, which usually show a pouch connected to the stomach by a narrow neck. There is no tenderness over this area. The diverticulum frequently retains barium after the stomach is empty. In the upright position a fluid level and a

FIG. 1. Anteroposterior view fifteen minutes after ingestion of barium.

gas bubble at its apex may be seen. It should be differentiated, however, from a perforating or penetrating ulcer; but in the latter we expect tenderness on palpation, sometimes incisura on the opposite side and, of course, an ulcer history in addition. The pressing, bursting type of pain, relieved by rest on the back and tenderness in the left costal margin may also be of some help in the diagnosis. In the roentgen examination the patient should be examined in both the upright and prone positions, and should be rotated in all directions as the sac is frequently obscured in the anteroposterior position when situated on the posterior wall of the stomach. A diverticulum at the pylorus or on the lesser or greater curvature will be more readily observed, whereas an additional gas bubble at the fundus region may be overlooked if the patient is examined in the upright position only. If it happens that there is a diverticulum on the posterior wall of the cardia, it will show plainly only if the patient is examined in the oblique view. In the case which we report, on two examinations the sac failed to fill in the upright position. On the third examination, only a small amount of barium could be forced into the sac with very firm pressure.

## TREATMENT

Jordan and Lahey[4] say that the treatment of diverticula of the stomach should be surgical, as irritation by the stomach contents may well be a predisposing cause of cancer; but they add that surgery in this region is frequently impractical and often impossible because of difficulty in immobilizing and dissecting the sac. In fact, Mayo[8] and Mellon[9] found a carcinoma at the bottom of a diverticulum and they are of the opinion that gastrointestinal diverticula favor malignancy.

## CASE REPORTS

The following case was observed first by Dr. Albert H. Sterns and referred to us for gastrointestinal study and treatment.

An American woman, housewife, aged thirty-eight, entered the Out-Patient Department of St. Luke's Hospital because of attacks of slight pressing pain under the xiphoid process associated with belching of seventeen years' duration. *Marital history:* She has been married seventeen years and has two healthy children. *Past history:* Appendectomy and right ovariectomy, 1916; abscess in right breast, 1926; and

FIG. 2. Lateral view six hours after ingestion of barium.

pelvic inflammation, 1931. *Gastrointestinal history:* Up to eighteen years ago, she never had any gastrointestinal trouble. She then began to have attacks of pressing pain in the epigastrium which became aggravated after she had been operated on for inflammation of the appendix and right ovary. The attacks lasted continuously for about six months and have been so distressing that she used to induce vomiting to get relief. After that period the attacks became less frequent. Occasionally every six or eight weeks, she might have slight pain under the ensiform process lasting for several days. However, an attack may be precipitated at any time by eating spicy or fried food; it is aggravated by deep breathing, and relieved by rest on the back, and by "bismuth powder."

She does not suffer from nausea, vomiting, or heartburn. Her bowels are regular. Her habits are good.

The *physical examination* is essentially negative, except for tenderness in the left costal margin.

*Laboratory Findings:* Urine negative. Kahn and Wassermann reactions negative. Gastric analysis: fasting contents—amount 74 c.c., free HCl 19, total acidity 28, guaiac weak positive. Microscopic: mucus, a few red cells, starch. One and a half hours after test meal (5 per cent alcohol): free HCl 45, total acidity 64, guaiac negative, benzidine positive.

*Roentgen Findings.* The stomach is atonic and the lower pole is at the promontory of the sacrum. Size, shape, outline, and peristalsis are normal. Except for the ptosis, nothing abnormal was noted in the stomach examination until the six hour period, when a barium residue was detected near the esophageal opening. There was no six hour residue in the stomach itself.

At a second barium examination it was possible to demonstrate the filling of the sac. The sac was about 3.5 cm. in diameter and connected to the stomach near the esophagus by a distinct neck. It was close to the lesser curvature on the posterior wall of the stomach.

After several weeks a third examination was made with exactly similar findings. At none of these examinations was any pathology found. The barium residue was still in the sac at forty-eight hours. It was not followed beyond this as Gray[1] has already reported barium remaining in the sac for seven days. There was no tenderness over the sac but there was tenderness over the costal margin.

Fig. 3. Twenty-four residue of barium in diverticulum.

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# THE REMOVAL OF LYMPH NODES IN CANCER OF THE CERVIX*

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IT TAKES some courage to come before a body of experts in the radiation treatment of cancer with a suggestion for more surgery. Nevertheless I hope to convince you that the plan I have to suggest is founded upon sound clinical experience and pathological studies and that the results thus far obtained since October, 1930, three and a half years ago, justify the hope that it may have some value. It consists of an application to cancer of the uterine cervix of methods successfully employed by many persons in cancer of the mouth, namely, irradiation of the primary tumor and surrounding tissues and surgical resection of the tributary lymph nodes. In my reading of foreign and American literature I could find no record of such a procedure having been attempted. When radical abdominal hysterectomy for cancer of the cervix was first suggested, removal of the tributary glands was done at the same time in a large proportion of the cases, but the mortality of this added surgical insult brought with it so high a primary mortality that it led to its abandonment except in very early cases in good physical condition. On the other hand, the astounding results obtained by the use of radium in curing the primary ulcer of the cervix and its surrounding infiltration were in part counterbalanced by the frequency with which lymph node metastases at the pelvic brim were encountered in subsequent years and the almost universal failure to produce more than temporary regressions of these metastatic nodules by deep roentgen therapy or implantation of radon seeds. We have no satisfactory explanation that I know of for this resistance to irradiation of cancer in the lymph nodes, yet it is an undeniable clinical fact, even in the most accessible glands, such as those in the axilla and groin.

Hence the suggestion seemed reasonable that, if we could devise a surgical resection of the lymph nodes tributary to the cervix that would be reasonably complete, and yet was not associated with a serious primary mortality, something might be gained. The important thing was to find out what cases might be suitable for this particular procedure. I excluded in the first instance the operable cases (Group I, League of Nations classification), since reasonably satisfactory results (50 per cent cures) were being obtained by either irradiation or surgery and because the number of cases showing gland metastases in this group was only 25 per cent. I also excluded the hopelessly advanced cases of Group IV, in spite of a lymph node involvement in 66 per cent of the patients, because of their bad operative risk and the probability of extrapelvic metastases. This left Groups II and III for consideration, in which the percentage of cases having lymph node metastases ranged from 45 to 50 per cent. These percentage figures represent the averages obtained by the numerous pathological studies of hundreds of pelvic lymph nodes made early in the present century. A further conclusion of these studies, confirmed by subsequent investigations, was that the tributary lymph nodes in cancer of the cervix could be divided into two groups, the Stage 1 glands first involved, consisting of the iliac, the obturator, the ureteral and sacral glands; and the Stage 2 glands involved later, consisting of the higher iliac, the lumbar, aortic, and deep inguinal glands. Stage 1 glands were involved in 90 per cent of the cases where cancer was found and only in

* Read at the Nineteenth Annual Meeting, American Radium Society, Cleveland, Ohio, June 11–12, 1934.

10 per cent were Stage 2 glands also involved. In practically no case was the metastasis found to be directly to a second stage gland without involving the first stage. It was also noted that the sacral glands were infrequently involved. If, therefore, the iliac, obturator and ureteral glands could be removed surgically, leaving the sacral and Stage 2 glands, we would have eliminated about four-fifths of the lymph nodes in which cancer metastases would be apt to occur. Pathologic examinations in cancer of the cervix also showed that lymph nodes were at times involved without parametrial thickening and that parametria might be densely infiltrated with lymph nodes uninvolved; furthermore, that enlarged, hard glands might be normal and smaller, softer ones might contain a metastasis.

Bearing in mind all these pathological findings and difficulties, a method of operation was devised that would permit of a reasonably complete lymph node resection with a minimum operative risk. Details of the operative technique will be found in another publication. Suffice it to say here that under spinal anesthesia, selecting patients who were not obese, it was possible to get a good exposure of the iliac gland region and complete the operation, as a rule, in less than an hour with but little shock to the patient except in the more advanced Group III cases. Removal of the adnexa simplified the exposure, removed hormonal stimulation in younger individuals, and diminished the uterine blood supply. Hence it was done in all cases with the lymphadenectomy (Fig. 1). Occasionally lymph nodes could not be found on one side but the total number of lymph nodes removed in the 26 cases subjected to operation was 85, that is between 3 or 4 glands to a case. Of these 85 glands there were 46 iliac glands, 32 obturator glands and 7 ureteral glands. In 2 cases the ureteral glands were found so closely attached to ureter and uterine vessels that their removal was deemed inadvisable. In 19 of the glands removed cancer was found his-

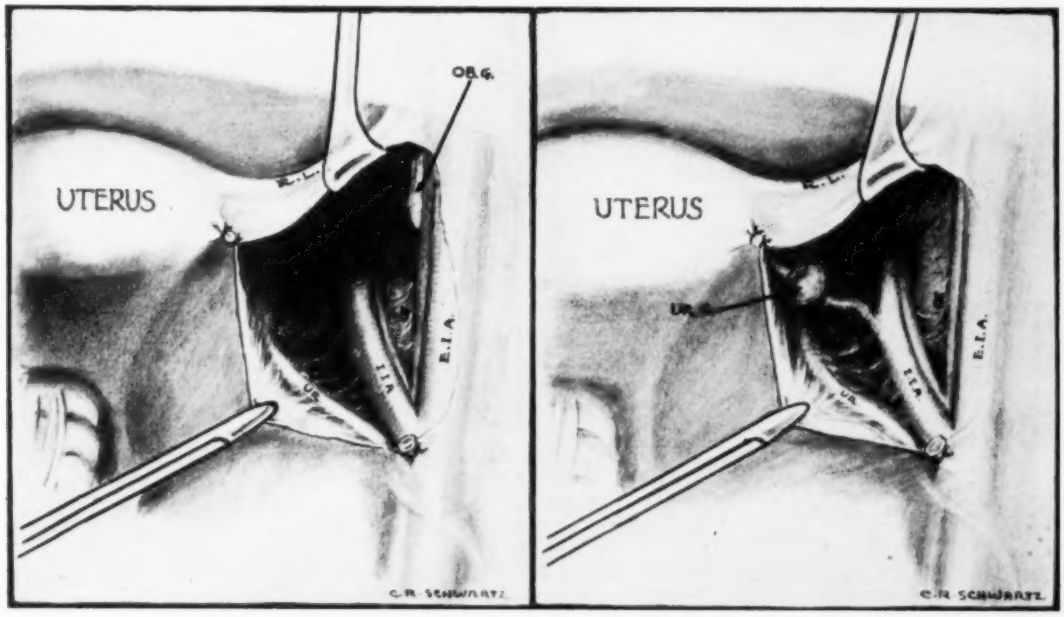


Fig. 1. Iliac lymphadenectomy. Left, exposure of obturator gland after removal of adnexa and iliac gland; right, exposure of enlarged ureteral gland after removal of obturator gland. *Ur.*, ureter; *I.I.A.*, internal iliac artery; *E.I.A.*, external iliac artery; *R.L.*, round ligament; *OB.G.*, obturator gland; *UR.G.*, ureteral gland.

tologically. Dividing the 26 cases treated into 18 cases classified as Group II cases and 8 Group III cases, cancerous glands were found in 8 of the Group II cases (44.4 per cent) and 4 of the Group III cases (50 per cent), or an average of 12 out of 26 (46.1 per cent) for the whole series. This sufficiently justifies the necessity of such lymph node removal.

The radiation treatment of the primary tumor varied somewhat in accordance with the involvement and external factors, such as the supply of radon seeds and radium available at the time. In all but 2 cases some irradiation was applied at the time of operation (radon seeds in 21 cases, radium alone in 3 cases, a combination of the two in 13 cases). The average total dosage given was 4,250 mg-hr. In one-half the cases a full dosage of 824 r roentgen radiation was given either before or after the operation. More recently we have preferred to precede operation by a complete course of roentgen treatment and radium application to the cervix.

Following the suggestion of Dr. Gellhorn to employ gold radon seeds of 1 to 1.5 mc. in strength by implantation through the abdominal incision into the pelvic connective tissue, I usually supplemented the intracervical irradiation by such an abdominal implantation. Six seeds of 1.5 mc. each totalling 1,200 mc-hr. were, as a rule, implanted as shown in Figure 2 in the sacrouterine ligaments and interiliac region. It was hoped that the sacrouterine seeds might inhibit metastases in the sacral lymph nodes. One disadvantage of the abdominal implantation of radon seeds was an apparent increased tendency to embolism. Both in Dr. Gellhorn's series of 20 cases and in my own series one such fatality occurred. Both patients had been perfectly well until the sixth and ninth day postoperative respectively, when a typical embolus death occurred. Apparently in these cases a gold seed was implanted into or near a large vein. With due care such an accident should be avoidable.

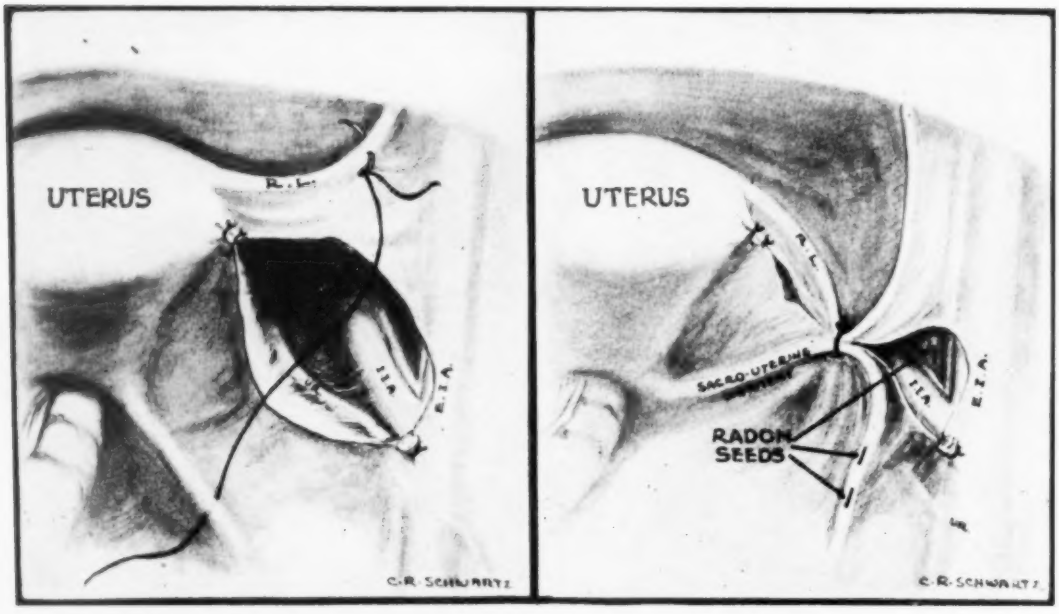


Fig. 2. Iliac lymphadenectomy. Left, closure of broad ligament wound; right, location of gold radon seeds. *I.I.A.*, internal iliac artery; *E.I.A.*, external iliac artery; *UR.*, ureter; *R.L.*, round ligament.

This brings us to the question of the primary mortality and final results of this method of treatment. As seen in Table 1

Table I

| | Total Number | Died Postoperative | Died Recurrent | Living Recurrent | Living and Well | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Total | 1 yr. or less | 1–2 yr. | 2–3 yr. | Over 3 yr. |
| Group II | 18 | 1 | 5 (12–21 mo. postop.) | 1 (3 mo. postop.) | 11 (5 ca. gland) | 3 | 3 1 ca. gland | 3 2 ca. gland | 2 2 ca. gland |
| Group III | 8 | 3 | 4 (3–9 mo. postop.) | | 1 1 ca. gland | | | 1 | |
| Total | 26 | 4 | 9 | 1 | 12 | 3 | 3 | 4 | 2 |

Table II

| | Number | Died | Recurrent | Living and Well |
|---|---|---|---|---|
| Under 40 years | 8 | 1 | | 7 (2 with ca. in glands) |
| Over 40 years | 10 | 5 | 1 | 4 (3 with ca. in glands) |
| Total | 18 | 6 | 1 | 11 |

only one death, and that from embolus, occurred in the 18 Group II cases. On the other hand, the more advanced cases of Group III (League of Nations classification) had a primary mortality of 3 out of 8 cases (2 peritonitis, 1 from liver necrosis). I am therefore convinced that this operation is not suitable for Group III patients.

Younger persons were preferably selected for this operation since they were usually better operative risks and less obese. Out of the 26 patients, only 5 had entered the menopause and 11 were under thirty-five years of age. Table II shows results in the 18 Group II cases according to age.

While the oldest case was treated only three and a half years ago, the number of those clinically well with cancer found in the lymph nodes removed justifies some hope for the future. Figure 3 shows such a cancerous lymph node removed from my first patient operated on, in October, 1930, and now clinically well (re-examined May 26, 1934). The size of the cancer metastases in lymph nodes is shown in Figure 4 (clinically well). Of special significance is the cancer metastasis in a ureteral lymph node shown in Figure 5. This patient had received 3,600 mg-hr. of radiation within the cervix at a distance of not over 3 cm. from

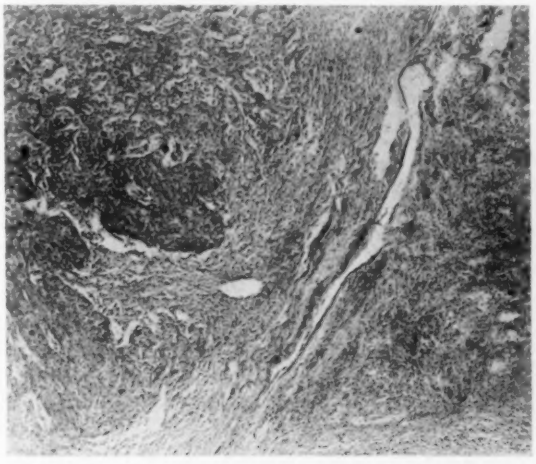

Fig. 3. Section from iliac gland removed from Case 1 operated on October 14, 1930, showing extensive cancer metastasis; free of recurrence on examination May 25, 1934.

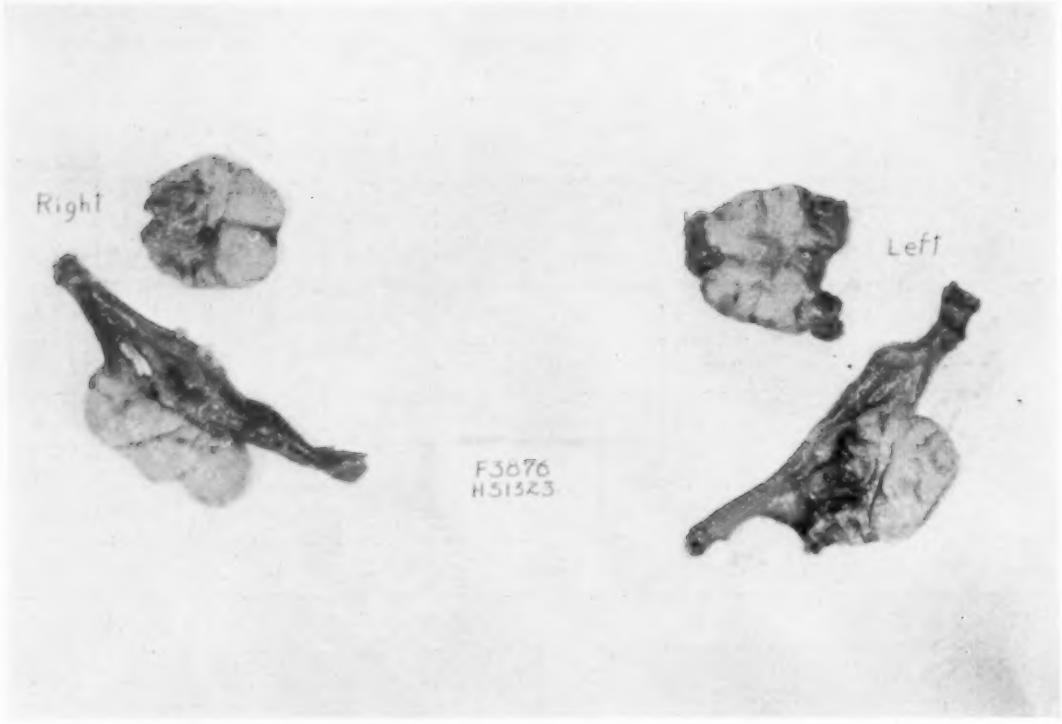


Fig. 4. Enlarged cancerous iliac glands, with tube and ovary for comparison to show size, removed by operation August 9, 1932. Still clinically well in April, 1934.

this gland four weeks previous to its removal and yet the cancer cells show no evidence of retarded growth. Such evidence would certainly seem to justify a trial of lymph node removal in selected cases.

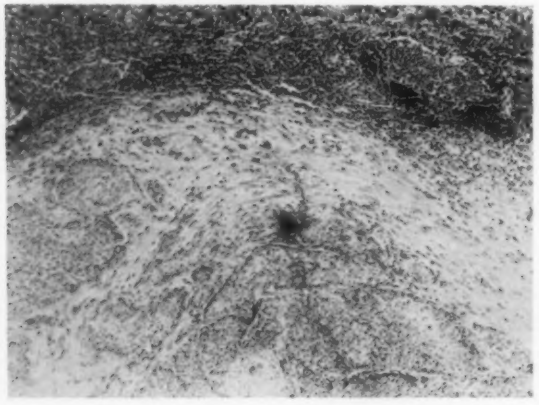

Fig. 5. Section of ureteral lymph gland with actively growing cancer nests, although 3,600 mg-hr. of radiation had been applied intracervically at a distance of 3–4 cm. from this gland four weeks previously.

In conclusion, then, we have attempted a combination of lymph node removal with irradiation in 26 Group II and Group III cases of cancer of the cervix. Our experience with the 8 more advanced Group III cases is distinctly discouraging. On the other hand, the 18 Group II cases with but one primary death due to embolus and with 11 of them still clinically well, although 5 of these 11 showed cancer in the glands removed, justify the belief that this method should be given further trial. My recommendation at present is that only patients in good physical condition, preferably young and not obese, be selected and that the operator should be reasonably experienced in pelvic cancer surgery. With these limitations, it is fair to hope that by this method we may materially increase the percentage of cures in our Group II cases of cancer of the cervix.

A brief analysis of the 26 case histories is herewith appended.

SUMMARY OF HISTORIES

*Group II Cases*

Case I (Barnard 45286) S. S., aged fifty-one, Para I, bleeding for six months, had a large everting carcinoma of the cervix with some thickening of both parametria. October 14, 1930, following cautery destruction of cauliflower mass, abdomen opened and after removal of left adnexa and a small subserous myoma, a large lymph node in the left iliac triangle was removed. No glands found in right iliac region. Eight gold radon seeds of 1.5 mc. each implanted, two in left iliac bifurcation and six in parametrium and sacrouterine ligaments encircling the cervix. On October 26, 1930, 150 mg. radium in brass implanted in cervix for twenty-two hours. Slight thickening still palpable around cervix, December 23, 1930, hence four gold radon seeds of 1.5 mc. implanted in left parametrium and cervix. Total radium dosage equalled 5,700 mg-hr. Histologic examination showed squamous carcinoma in cervix and large metastasis in left iliac gland. On June 16, 1931, the patient was clinically well, and had gained in weight from 121½ to 144½ lb. On March 15, 1934, examination showed the patient to be clinically well; weight 145 lb.

Case II (Barnard 45691). L. S., aged forty-two, Para III, bleeding for four months, showed cervix completely involved, with thickened parametria. On December 2, 1930, the abdomen was opened and after removal of both adnexa, a hard gland 3×2 cm. in left region was removed. Six seeds of 1.5 mc. each implanted in sacrouterine ligaments and broad ligament. After closing abdomen, 75 mg. radium was implanted in the cervix for twenty-two hours. On December 30, 1930, radium was reapplied to the cervix, 75 mg. for twenty-three hours. Good result with gain from 115 to 138 lb. in weight by June 8, 1931. Suspicious thickening of the cervix, hence on July 6, 1931, six radon seeds were implanted around the cervix and on August 11, 1931, another six seeds to the cervix. There was considerable necrosis (overdosage?); marked sclerosis. After a drop in weight to 130½ lb. on August 31, 1931, there was an increase to 140 lb. by January 21, 1932, when she was clinically well. Her condition was unchanged until November 28, 1933, when a small local recurrence was treated by means of six more radon seeds of 1.5 mc. each, with complete disappearance. Total radium dosage, 8,275 mg-hr. Histologic examination of iliac lymph gland showed cancer metastasis. Clinically well on examination March 5, 1934; weight 137½ lb.

Case III (Barnard 48130). N. F., aged twenty-two, Para II, bleeding for three months, showed entire cervix and almost entire left parametrium involved. On September 8, 1931, both adnexa were removed and a large gland, 5×1.5 cm., removed from each iliac angle. Nine radon seeds of 1.5 mc. each were implanted in sacrouterine and broad ligaments and after closure 80 mg. radium was applied to the cervix for twenty hours. There was good regression but on November 3, 1931, five radon seeds of 1.5 mc. were applied to a nodular thickening in left cervix and parametrium. She gained in weight from 134 to 147 lb. by May 16, 1933. Five radon seeds totaling 9 mc. were applied to a small local recurrence in the vault on June 6, 1933. Examined March 29, 1934, and found clinically well. Glands showed no carcinoma. Total radium dosage, 4,460 mg-hr.

Case IV (Barnard 48570). F. P., aged fifty-eight, Para IV, symptoms for six months, showed both parametria thickened with slight vaginal extension. From October 27 to November 3, 1931, received 700 r, roentgen radiation. On November 6, 1931, a laparotomy was performed, with removal of both adnexa, right ureter dilated, two enlarged glands removed from each side. Eight radon seeds were placed in the sacrouterine ligament and in thickened parametrium, close to uterine vessels on right side. The lymph glands in the left side showed cancer microscopically. On the evening of the sixth postoperative day after normal course, with temperature 99.4° F., pulse 90, respiration 20, the patient suddenly gasped for breath and died within half an hour. No autopsy was performed but it seemed certain that death was due to embolus. Total dosage (incomplete) was 1,600 mg-hr.

Case V. Mrs. G. (private patient), aged thirty-two, Para II, pregnant three months with bleeding for two months and involvement of entire cervix and some parametrial thickening. On October 20, 1931, 100 mg. radium was applied to the cervix for thirty-six hours by Dr. S. Abrams. On November 5, 1931, spontaneous abortion occurred. On December 4, 1931, I was called in consultation. At laparotomy both adnexa and three iliac glands were removed. On the left side two hard enlarged ureteral glands were felt and removed after

ligating the uterine ligament. Five radon seeds were implanted into the sacrouterine ligaments and iliac bifurcation. Microscopic examination of ureteral glands showed actively growing cancer (3,600 mg-hr. of radiation four weeks previously applied at 3–4 cm. distance from these glands). On December 21, 1931, the patient was given 880 r roentgen radiation. A local recurrence in August, 1932, was treated with diathermy. In December, 1932, a chest metastasis was diagnosed. Died January, 1933. Total dosage, 4,600 mg-hr.

CASE VI (Barnard 48969). L. W., aged forty-two, Para V, symptoms for nine months, showed involvement of two-thirds of cervix and one parametrium almost to the wall. On December 11, 1931, both adnexa, right iliac and left ureteral glands removed. Six gold seeds of 1.5 mc. each implanted in sacrouterine ligament and iliac bifurcation. On December 29, 1931, 100 mg. radium applied to cervix for twenty-two hours. Microscopic examination of lymph glands showed carcinoma. Total radium dose, 3,400 mg-hr. On June 1, 1933, the patient was feeling well; no recurrence. On March 24, 1934, she was gaining in weight; no recurrence.

CASE VII (Barnard 48954). A. C., aged thirty-one, Para III, symptoms for two months, cauliflower carcinoma of the cervix with vaginal and slight parametrial involvement. On December 15, 1931, typical large glands removed from both sides with three gold seeds of 1.5 mc. each implanted in sacrouterine ligament and bifurcation on each side, and 100 mg. of radium placed in cervix for twenty-two hours. On January 26, 1932, 50 mg. radium placed in cervix for twenty-four hours. Total radium, 4,600 mg-hr. Clinically well on May 31, 1932, with gain from 168 to 182 lb. Weighed 193½ lb. on October 9, 1933. Examined March 20, 1934, clinically well. Cancer metastasis found microscopically in left iliac gland.

CASE VIII (Barnard 48987). M. C., aged fifty-three, Para II, symptoms for two months, both parametria moderately involved. On December 11, 1931, radium was applied to the cervix for a total of 3,150 mg-hr. On January 12, 1932, glands removed from both sides, definitely carcinomatous on left side. Three radon seeds on each side and 50 mg. radium placed in cervix for twenty-four hours. Good immediate result; gain from 185 to 194½ lb. Roentgen irradiation given prophylactically in October, 1932, and repeated in November, 1932, total amount 1,205 ma-min., probably excessive. Severe hemorrhage with necrosis of cervix December 19, 1932. Rectovaginal and vesicovaginal fistulae developed. She died with recurrence on October 25, 1933. Total radium dosage 5,550 mg-hr., plus roentgen irradiation. Left iliac lymph gland showed carcinoma.

CASE IX (Barnard 48910). M. S., aged fifty-two, colored, Para V, symptoms over three months, cervix, upper vagina and left parametrium involved with fibroid uterus. On December 7, 1931, 150 mg. radium was placed in the cervix for twenty-one hours, 3,150 mg-hr. On January 19, 1932, the fibroid fundus of the uterus was removed with the adnexa for technical reasons. Two large glands on the left side and one on the right side were removed. Two gold seeds of 1.5 mc. were placed in each sacrouterine ligament and 50 mg. radium implanted in the cervix for twenty-four hours. Total radium dosage, 5,150 mg-hr. Good immediate result. There was a recurrence on January 25, 1933 and the patient died on May 31, 1933. No cancer found in the lymph glands.

CASE X (Barnes Hospital). B. C., aged fifty-five, colored, Para II, bleeding for two months; both parametria somewhat thickened. On April 21, 1932, lymph glands were removed. No radon seeds available but 100 mg. of radium placed in the cervix for thirty-six hours. Small recurrence on November 14, 1932, was treated by radium to the cervix with a dosage of 1,170 mg-hr. The patient died of recurrence on June 24, 1933. No cancer in lymph glands.

CASE XI (Barnard 51323). S. H., aged thirty-four, Para IV, symptoms for two years, entire cervix and some involvement of both parametria. On August 9, 1932, adnexa removed and unusually large, evidently malignant glands removed from both iliac triangles (Fig. 8). Smaller obturator glands also found. Difficult dissection. Radium and radon seeds not available on that day. On August 27, 1932, radium applied to cervix, 150 mg. for twenty-two hours—3,300 mg-hr. By December 15, 1933, the patient had gained 20 lb. and was clinically well. She was examined March 10, 1934, and found clinically well. Cancer found in both iliac glands.

CASE XII (Barnard 52405). B. L., aged thirty-four, Para O, symptoms for three months, cervix involved with left parametrium thickened. On November 22, 1932, typical lymphadenectomy with five gold radon seeds implanted in sacrouterine and iliac triangle and 85 mg. of radium in the cervix for twenty-five

hours. On December 16, 1932, additional 50 mg. radium to cervix for twenty-four hours. Total radium dose, 4,375 mg-hr. In December, 1932, roentgen radiation up to 900 ma-min. given. The patient gained from 96½ to 129 lb. in weight and was perfectly well November 28, 1933. Lymph glands show only hyperplasia. Reported through relative in good health April 30, 1934.

Case XIII (Barnard 52641). B. K., aged forty-two, Para I, symptoms for nine months, cervix and both parametria partly involved. On December 9, 1932, two iliac glands from right side and one ureteral gland from the left side removed. Five gold seeds implanted abdominally and 150 mg. of radium placed in cervix for twenty-two hours. Total radium dosage, 4,360 mg-hr. Temporary improvement. Roentgen treatment in April, 1933 (450 ma-min.). Colostomy for obstruction on September 29, 1933. Died January 1, 1934. No carcinoma in lymph glands.

Case XIV (Barnard 52779). A. H., aged fifty-six, Para IV, symptoms for one year, cervix and left parametrium involved extensively. On December 20, 1932, she was given roentgen irradiation totalling 900 ma-min. On January 31, 1933, typical lymphadenectomy with implantation of three gold seeds in each side. Total radium dosage, 4,500 mg-hr. July 21, 1933, clinically well. March 12, 1934, gaining in weight, clinically well. No cancer found in lymphatics.

Case XV (Barnard 55068). E. de W., aged thirty-four, Para I, symptoms for five months, cervix and slight parametrial involvement. On August 8, 1933, the patient received 900 ma-min. roentgen therapy. On September 8, 1933, typical lymphadenectomy. No radon seeds available on that day and 150 mg. of radium applied to cervix for only fourteen hours by mistake. Hence on November 28, 1933, additional radon seeds given vaginally into parametrium for a dosage of 1,200 mc-hr. Total radium dosage, 3,300 mg-hr. On March 16, 1934, clinically well, with a gain of 14 lb. in weight in previous three months. No cancer found in glands.

Case XVI (Barnard 55991). B. McC., aged thirty-four, Para I, symptoms for three months, entire cervix and beginning parametrial thickening. On November 3, 1933, roentgen radiation up to 900 ma-min. On December 5, 1933, numerous lymph glands removed, including right ureteral gland. No radon seeds available; 115 mg. radium applied to cervix for twenty-eight hours. Small pyometra developed December 29, 1933, but after drainage condition good. On March 20, 1934, found clinically well and gaining in weight. Total radium dosage, 3,230 mg-hr. No cancer found in lymph glands.

Case XVII (Barnard 56150). B. S., aged forty-eight, Para II, left parametrium and cervix involved. On November 17, 1933, she was given 900 ma-min. roentgen radiation. On December 15, 1933, at laparotomy were found large adnexal swellings (chronic hydrosalpinx). Typical lymphadenectomy followed by 115 mg. of radium to cervix for twenty-six hours. On February 9, 1934, additional 2,000 mg-hr. of radium to the cervix. Total radium dose, 5,000 mg-hr. Cervical necrosis with hemorrhage and probable recurrence on April 1, 1934. No cancer in lymph glands.

Case XVIII (Barnard 56359). V. K., aged twenty-nine, Para II, symptoms for two months, large involvement of the cervix with left-sided parametrial thickening. On December 8, 1933, roentgen radiation of 900 ma-min. On January 2, 1934, 115 mg. radium applied to cervix for 28⅔ hours—3,246 mg-hr. On January 30, 1934, lymphadenectomy including removal of left ureteral gland and several large iliac glands. On March 2, 1934, 75 mg. of radium applied for twenty-four hours to cervix. Total radiation, 5,046 mg-hr. plus 900 ma-min. Good immediate result. No cancer found in lymph glands.

*Group III Cases*

Case 1 (Barnard 48693). I. F., aged forty, Para II, symptoms for several months, involvement of entire cervix, upper vagina and both parametria extensively. On November 10, 1931, typical lymph gland removal with large glands found on each side. Three radon seeds implanted on each side and 100 mg. of radium placed in cervix for 21½ hours. On December 22, 1931, additional radium to cervix of 1,200 mg-hr. Beginning February 2, 1932, roentgen radiation of 900 ma-min. On September 13, 1932, an additional 700 ma-min. On November 10, 1932, development of a cervical slough apparently due to over-irradiation. Gradual increase in weight from 119 to 133 lb. on May 15, 1933. Total dosage of 4,550 mg-hr. plus 1,600 ma-min. Ureterovaginal fistula developed December 8, 1932. On March 9, 1934, no evidence of carcinoma although fistula persists with weight increased to 136½ lb. Lymph glands on both sides showed carcinoma.

CASE II (Barnard 45142). M. G., aged forty-two, Para III, symptoms for two years, entire cervix and both parametria extensively involved. On January 29, 1932, operation complicated by adhesions and salpingitis. Glands removed from both sides. Three radon seeds of 1.5 mc. each placed in each side; 50 mg. of radium to cervix for twenty-four hours. Total radiation of 2,400 mg-hr. Died five days after operation of peritonitis. No cancer found in lymph glands.

CASE III (Barnard 50704). B. H., aged thirty-two, symptoms for six months, partial cervix amputation three months ago, entire right parametrium involved with infiltration of left side also. On June 29, 1932, 150 mg. of radium applied to cervix for twenty-seven hours—4,050 mg-hr. Fairly favorable result, hence on September 13, 1932, laparotomy, removal of double-sided infected adnexa with small pus sac. Only one iliac lymph gland found. Five radon seeds implanted. Stormy postoperative course. Re-opened for localized peritonitis. Colostomy December 14, 1932, for partial obstruction. Total radiation, 5,250 mg-hr. Died of recurrence in May, 1933. Lymph gland showed no carcinoma.

CASE IV (Barnard 51848). A. O., Eskimo Indian, aged thirty-three, Para VII, symptoms for several months. Entire cervix and both parametria extensively thickened. On September 27, 1932, 150 mg. radium to cervix for twenty-two hours. On October 18, 1932, lymphadenectomy with glands found only on right side, followed by three radon seeds implanted on each side. On November 11, 1932, roentgen radiation of 900 ma-min. Only temporary improvement. Recurrence noted March 10, 1933. Died July 9, 1933. Total radiation, 4,500 mg-hr. plus 900 ma-min. Iliac glands showed cancer.

CASE V (Barnard 47595). L. B., colored, aged twenty-five, Para O, symptoms for three months, slight infiltration of parametria at first visit July 3, 1932; did not return for treatment until November 4, 1932, at which time both parametria were extensively infiltrated; 150 mg. radium to cervix for twenty hours. On January 27, 1933, lymphadenectomy with four radon seeds implanted in sacrouterine ligaments. April 7, 1933, roentgen radiation of 800 ma-min. Recurrence July 3, 1933. Died October 30, 1933. Total dosage of radium, 3,800 mg-hr. plus 800 ma-min. roentgen radiation. No cancer in glands.

CASE VI (Barnard 55549). M. L., aged forty-four, Para VII, symptoms for eleven months, inverting growth of cervix with both parametria markedly thickened. On September 19, 1932, began roentgen radiation of 800 ma-min. On October 13, 1933, applied 150 mg. radium to cervix for $26\frac{2}{3}$ hours. On November 21, 1933, laparotomy. Very numerous large lymph glands found with one ureteral node firmly attached to right ureter. On left side similar adherent ureteral lymph gland. Four radon seeds placed in these glands. Radium placed in cervix, 50 mg. for twenty-four hours. Stormy postoperative course. Died February 28, 1934, probably recurrent. Carcinoma found in glands of both sides.

CASE VII (Barnard 56249). C. C., aged forty-three, Para VII, symptoms for six months, both parametria and cervix extensively thickened. On November 28, 1933, began 900 ma-min. of roentgen radiation. On January 5, 1934, difficult operation with many old inflammatory adhesions. Left ureteral gland too adherent to remove. Eight radon seeds of 2.1 mc. each placed in sacrouterine ligaments and iliac bifurcation area followed by cervical application of 115 mg. radium for twenty hours. Stormy postoperative course with pelvic peritonitis and death four weeks later on February 1, 1934. Autopsy showed generalized peritonitis but no carcinoma found in glands at autopsy. No cancer found in glands that were removed. Total radiation, 4,534 mg-hr. plus 900 ma-min.

CASE VIII (Barnard 56403). T. V., aged forty-seven, Para III, symptoms for six months, involvement of vagina and left parametrium almost to pelvic wall. On December 12, 1933, roentgen radiation of 900 ma-min. On January 9, 1934, lymphadenectomy without difficulty. Eleven gold seeds of 1.1 mc. each implanted in sacrouterine ligaments and pelvic connective tissue and 75 mg. of radium placed in cervix for $26\frac{2}{3}$ hours. Total dosage equalled 3,515 mg-hr. Patient developed a temperature that reached 108° F. forty-eight hours later when she died. Autopsy showed no peritonitis but marked changes in liver, parenchymatous degeneration and extensive fatty infiltration indicating a seriously damaged liver function before operation. Many large lymph nodes about aorta. None of the glands removed at operation or autopsy showed carcinoma.

DISCUSSION

Dr. George E. Pfahler, Philadelphia. The big objection to the method described by Dr. Taussig is that it requires operation. I think the thing the surgeon should learn and we should learn is that the further we can keep away from operations the earlier we will get cancer patients. Today a patient hides his cancer from his family and from his physician, until he can no longer hide it, because of the fear of operation. I have in mind the wife of one of our leading surgeons of the East who, after having cancer of the breast for two years, was brought to Dr. Deaver in an inoperable condition. I treated her for four to six months and then Dr. Deaver operated with complete success, and this is an example. This woman knew that as soon as she spoke of a cancer of the breast she would be taken to a surgeon, and that is the general rule. We will do a whole lot for the control of cancer if we let people know that a portion of these cases can be made well without operation.

Dr. Taussig (closing). In my experience, especially during the past five to ten years, many patients have come to me saying they did not wish to have radium used but would consent to anything in the way of operation. That, of course, has been due to bad irradiation. It is also because of bad and untrained surgery that the criticism of cancer surgery has come about. I think we should not work against each other but together. I am very much in favor of men who do surgery using radium and men using radium doing surgery, provided they are limiting themselves largely to tumor work.

# PULMONARY CHANGES ASSOCIATED WITH UPPER RESPIRATORY TRACT ABNORMALITIES AND DISEASES

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RECENT medical literature has contained several references to the deviations from the normal which may occur in the lungs as a result of infection in the paranasal sinuses, to the paths over which the infection may travel from the sinuses to the lungs, to the evidences of pulmonary pathology as seen in the roentgenogram, and to the symptoms which such sinus infections may produce. That these same symptoms and roentgen changes may be due to abnormalities, other than sinus infections, in the upper respiratory tract has not been as well emphasized. It is the purpose of this study to call attention to several of these abnormalities and pathologic conditions and report one case in each group.

Mullin[7] traces the path of infectious material from the sinuses through the lymphatics and the right side of the heart to the lungs. Burgess[2] mentions "laryngeotracheitis, chronic bronchitis, bronchiectasis, non-tuberculous basilar infection and apical catarrh" in connection with the paranasal sinuses. Wasson[9] speaks of the relationship of the sinuses and bronchi. Dunham and Skavlem[5] describe the lung pathology and its resemblance to incipient tuberculosis and say that it is secondary to chronic sinus infection. Buck[1] reports the findings in 316 patients with nasal accessory sinusitis out of 2,071 patients examined for suspected pulmonary tuberculosis.

There are not as many references in the literature to the changes in the lungs which are produced by the other upper respiratory tract abnormalities. That they do exist has been reported several times. Wasson[9] makes mention of this fact. He says, "The infection will manifest itself more prominently in a certain portion of the respiratory tract. This may be due to some peculiar anomaly, as a deviated septum of the nose, or to some variation in the bacterial flora. Again, certain parts of the respiratory tract are designed to bear the brunt of infection and trauma. It is easy in each condition to lose sight of the fundamental pathology involving more or less the entire respiratory tract and to think of sinusitis, tonsillitis or bronchitis."

Davis[4] speaks of nasal and oral septic conditions and their influence on the lungs and gastrointestinal tract and urges the physician to search for latent infections. Hawes[6] with C. O. Day reports that in suspected tuberculosis cases in adults the upper respiratory tract conditions were as follows:

| | Cases |
|---|---|
| Chronic tonsillitis | 23 |
| Deviated septum | 14 |
| Chronic rhinitis | 13 |
| Chronic pharyngitis and laryngitis | 8 |
| Disease of sinuses | 8 |
| Chronic tracheitis | 4 |
| Vasomotor rhinitis | 3 |
| Infected adenoids | 2 |
| Hypertrophied turbinates | 1 |

In 22 patients under 15 years of age, the relationship was as follows:

| | Cases |
|---|---|
| Infected tonsils and adenoids | 18 |
| Sinus disease | 10 |
| Chronic rhinitis | 7 |
| Chronic pharyngitis and laryngitis | 4 |
| Deviated septum | 2 |
| Vasomotor rhinitis | 1 |
| Nasal polyp | 1 |

In 26 cases of pulmonary tuberculosis listed as Ph I and Ph II, without tuberculous laryngitis, he remarks about the rarity of sinus infections and concludes that the

tonsil is the chief offender. Dr. Day's findings in these cases were as follows:

| | Cases |
|---|---|
| Chronic tonsillitis | 15 |
| Deviated septum | 7 |
| Chronic pharyngitis and laryngitis (non-tuberculous) | 5 |
| Disease of sinuses | 5 |
| Chronic rhinitis | 4 |
| Hypertrophied lateral bands | 1 |
| Nasal polyp | 1 |
| Polyp vocal core | 1 |
| Hypertrophied turbinates | 1 |

Reference to these three tables shows that other conditions than sinus infections occur more frequently than the sinus diseases themselves. Tonsillitis and deviated septum hold precedence in these tables.

It is the purpose of this study to refer to one typical case of bronchosinusitis disease and to report one each of the several types of infection and abnormality, other than sinus disease, which were found accountable for the pulmonary changes as seen on the roentgenogram. In one of these patients, the sinusitis was complicated by tonsillitis, and in another there were sinusitis and otitis media. In these two instances the infection, other than the sinusitis, seemed to be the cause of the pulmonary symptoms.

It is important, when ruling out sinus infection in these patients, that all other possible sources of infection be searched for and the entire head and neck be examined for foci.

That non-infectious abnormalities of the upper respiratory tract may produce pulmonary changes and be associated with symptoms referable to the lungs was pointed out by Bushnell[3] many years ago. He reported several instances in which men were adjudged unfit for military service, on an erroneous diagnosis of pulmonary tuberculosis. They were later admitted to the army after the abnormalities of the nose and throat were discovered and successfully treated. He called attention to the phenomenon in which there is much less expansion on one side of the chest during deep inspiration if the nostril on that same side be tightly closed with the finger. Hawes[6] lists deviated septum as occurring 14 times in the adult cases and 2 times in the children's cases. Infected adenoids were found in 2 adults and hypertrophied turbinates in one. In the early tuberculous patients, there were 7 with deviated septum and 1 with hypertrophied turbinates.

The changes in the lungs as noted on the roentgenogram have been variously described. Wasson[9] thinks that the root of the lung receives the force of the first attack. He says "The hilum of the lung soon becomes a mass of connective tissue and, when viewed by means of the roentgenogram, the inflammatory reaction is well limited to the hila. Later the congestion and fibrous tissue increase may spread outward along the bronchi and arteries to invade even the primary lobules." Reisman[8] says: "The X-ray plates reveal lesions varying from moderate hilum glandular enlargement with nodulation to central consolidation with interlobar pleurisy resembling the juvenile type of tuberculosis." In speaking of the diagnosis of non-tuberculous lesions in children suspected of having tuberculosis, Wolff and Stone[10] say that "The normal markings seen beyond the hila are due to a combination of bronchi and vessels, the vessels assuming a more important rôle as the periphery is approached. It is definitely known that vascular congestion produces increased shadows. Whether other increases in the markings are due to fibrosis of the peribronchial tissue or to decreased elasticity of the lung, and hence to lessened vibration, is still uncertain." Considering the wide variation in the language and expressions used by various authors to describe the same changes as seen on the roentgenogram, the above opinions are not markedly dissimilar.

There is some discussion as to whether or not the enlargement at the hilus is due to fibrosis, normal connective tissue increase, lymphadenitis or congested blood

vessels. It is questionable whether or not normal bronchi, of the second division and smaller, are visible in a well made chest roentgenogram. Considering the fact that cartilage, in other parts of the body, is not normally visible in the roentgenogram, and that blood and blood vessels are visible, especially in the lungs, it seems probable that most of the so-called "bronchovascular tree markings" are due to blood vessels, especially in the middle and outer zones. If this is true, then only pathologic bronchi cast shadows. Not all the lung markings which resemble bronchi are vessels, for definite cylindrical enlargements and sacculations may be seen in bronchiectasis. In the more marked cases fluid levels are sometimes noted in the sacculations.

Regardless of whether or not the cause of the secondary findings in the lungs is sinusitis or some other pathology, the markings, as seen on the roentgenogram, are astonishingly similar. There is a definite increase in the visibility of the markings which extend outward from the hilus into the lung fields. Not only are they more dense in quality of shadow cast but they seem to be uniformly increased in width. The hila show some exaggeration due to connective tissue increase but there is usually no marked glandular enlargement. The lines of the bronchovascular tree do not, as a rule, touch the periphery of the lung and only in the most severe cases is there any evidence of parenchymal involvement. In these severe cases the parenchymal involvement seems to be due to an encroachment of interstitial fibrosis upon the lobules and is best seen between the primary lower lobe bronchi and the mediastinum.

The actual increase in the diameter of the shadows of the lung markings may be due to a chronic passive congestion or to an increase in the thickness of the walls of the bronchi, the result of relaxation of the musculature and lessened contractibility. This is accompanied by venous congestion and some increase in the interlobular interstitial tissue. In all patients there is some loss of elasticity of the air cell with a limitation of diaphragmatic excursion and shallow breathing.

The pulmonary changes as seen on the roentgenogram are not transitory. They persist for years after the removal of the focus of infection and after all the pulmonary symptoms have subsided. It is apparent from their permanence that these changes cannot be of an acute or even a subacute nature, such as passive congestion or edema. The persistence of the findings should lead us to believe that the changes are due to perivascular, peribronchial or interstitial fibrosis or any combination of these three. The apparent loss of elasticity of the air-bearing tissue, the diminished diaphragmatic excursion, the decreased pulmonary capacity, and the tendency of the neglected cases to go on to definite pulmonary pathology, such as bronchiectasis and bronchiectatic abscess, certainly speak against the possibility of the reactions being of a transitory nature. Figure 1 is a reproduction of the roentgenogram of a chest taken thirteen years after recovery from all symptoms following adequate therapy for the upper respiratory tract abnormality. The changes shown are no different from those seen in the roentgenogram taken fourteen years before, which was one year before treatment was begun.

Of the 7 patients here reported, 4 have been under observation many months and 3 have been observed over a period of several years. In all the patients the diagnosis of upper respiratory tract abnormality was made from the chest roentgenograms, and, at the earnest request of the roentgenologist, especially in our earlier experience, the attending physicians looked to the upper respiratory tract for the cause of the chest symptoms. Some of them were with difficulty persuaded, in the beginning, to look for trouble in the mastoids, throat and nose if the sinuses, on clinical and roengten examination, were found to be negative.

The first case reported in this series is quite typical of bronchosinusitis disease as commonly understood.

Case 1 (A–1100). E. D., female, aged thirty, a graduate nurse, had complained of productive cough, fatigue, post-nasal discharge, an occasional night sweat and some loss of weight and strength for a period of two years previous to her admission to the hospital on March 11, 1930. On the morning of her admission she fainted while on duty. From the history and a rather incomplete physical examination, a clinical diagnosis of pulmonary tuberculosis was made. Stereoroentgenograms of the lungs revealed no evidence of past or present tuberculous infection but showed the markings characteristic of an upper respiratory tract infection or abnormality. At the suggestion of the roentgenologist, roentgenograms of the sinuses were made. Two days later the left maxillary sinus was operated upon, drainage established and the sinus irrigated. Suction was employed for several days following operation. No other treatment was given. She was discharged from the hospital on the fourth day following operation and was allowed to return to duty. Up to

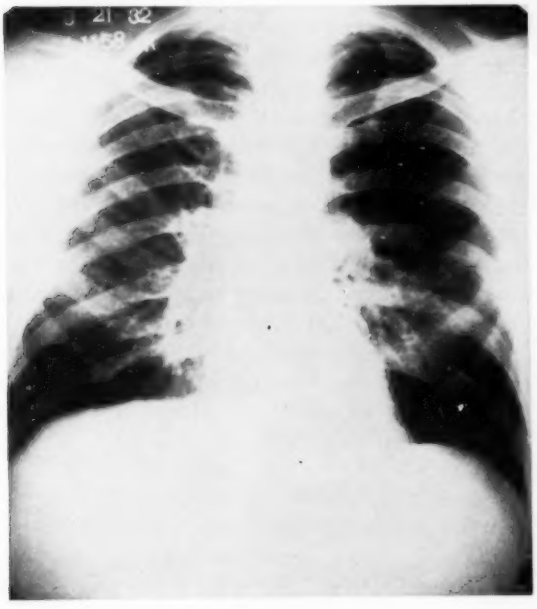

Fig. 1. Patient A-1158. This reproduction shows the persistence of the lung changes as viewed on the roentgenogram. The changes are permanent and not due to any acute or subacute pathology. This film was made thirteen years after all signs and symptoms had subsided.

Fig. 2. Case 1. Typical bronchosinusitis disease. Increased lower lobe bronchovascular tree markings with some hilar exaggeration. Chronic bilateral maxillary sinusitis, the left side worse than the right.

November 1, 1932, she has had no recurrence of the cough, is perfectly well and has gained 12 pounds in weight. Figure 2 is a reproduction of the roentgenograms of this patient.

The second patient is one of a group of patients in whom nasal obstruction is the cause of the changes in the pulmonary markings as seen on the roentgenogram. This patient had marked evidence of absorption of toxins which had manifested itself as "arthritis," myalgia, acute bronchitis, pharyngitis and laryngitis. These symptoms had existed over a period of

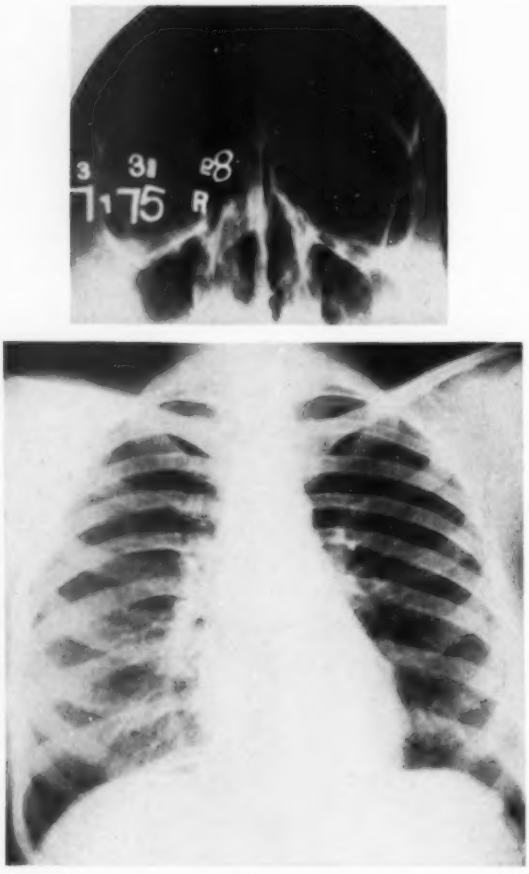


FIG. 3. Case II. The reproductions show no sinus pathology. The nasal obstruction is marked. The lungs show the typical findings of upper respiratory tract infection.

more than five years and were very annoying. She procured relief through the means of the operation on her nasal septum.

CASE II (7175). V. M., female, aged nineteen, student nurse, was admitted to the hospital on January 27, 1926, with a diagnosis of "acute arthritis, myalgia and acute bronchitis." Covering a period of more than five years, she had had repeated attacks of acute coryza with cough that had only ceased to be annoying during the warm days of summer. She had had the usual diseases of childhood but no serious illness. For the past week the cough has been particularly annoying, the result of exposure to cold. At the same time she began to have chilly sensations and her legs and arms began to ache. After enduring these discomforts for six days without improvement she entered the hospital. Her family history was negative. General appearance healthy. Throat and nose showed red and swollen mucous membrane and some seropurulent exudate. Mouth and tongue clean and teeth in good condition. The lungs showed no impairment of resonance and no palpatory changes. Over both lungs were a few scattered, rather coarse râles. All the voluntary muscles of the trunk and extremities seemed sore and tender. No evidence of joint involvement and no limitation of joint motion.

The urine was negative. Hemoglobin 90 per cent. The red blood cell count was 6,000,000. The leucocytes numbered 15,000. No differential white cell count was made. The temperature ranged from 98 to 99.5° F., the pulse from 75 to 85 beats per minute and the respirations from 18 to 24 per minute during her stay in the hospital. She was discharged on the ninth day after admission as "improved."

During the following thirteen months she was admitted to the hospital five times with the following diagnoses: second admission, "acute rhinitis and pharyngitis" and discharged on the fourth day as "improved"; third admission, "acute rhinitis and pharyngitis" and discharged on the fifth day as "improved"; fourth admission, "acute rhinitis and bronchitis" and discharged on the seventh day as "improved"; fifth admission, "deflected septum complicated by acute nasal infection and influenza" and discharged on the fourteenth day as "improved"; sixth admission, "acute rhinitis and bronchitis with deflected nasal septum." After the subsidence of the acute symptoms a submucous resection of the nasal septum was done on February 20, 1927. She was discharged from the hospital on the thirteenth day, this time as "cured." Since that time she has had no recurrence of her upper respiratory symptoms, either acute or chronic. Her cough has disappeared and she has been well except for an attack of acute appendicitis with operation on October 17, 1927.

Figure 3 shows the appearance of the lungs and sinuses in this patient. The sinuses are negative but the obstruction of the nares is plainly noticeable. The lungs show the typical markings of an upper respiratory tract infection or abnormality.

The third patient presents a malformation often encountered which is almost always productive of symptoms. She had repeated attacks of "sore throat" with its

common sequelae. It was supposed that removal of the tonsils would give complete relief. No abatement of the symptoms followed the tonsillectomy and complete relief came only following submucous resection of the nasal septum.

Case III (A-248). D. C., female, aged thirty-five, housewife, was treated as an out-patient during October 1929. For the last ten or twelve years she has had a hacking cough that was particularly troublesome during the winter months. A cold contracted in the late summer or early autumn would continue during the entire duration of cold weather and would be accompanied by some loss of weight, some expectoration, considerable soreness in the chest and a marked feeling of weakness. She has had many attacks of "sore throat" and one attack of paratonsillar abscess previous to the removal of the tonsils in August, 1929. She has always had marked difficulty in breathing through her nose. Between August, 1929, and October, 1929, there was no improvement in her condition. Roentgenograms of her lungs and sinuses were made on October 10, 1929. The lungs showed the typical markings of an upper respiratory tract abnormality. Although the sinuses were negative there were a marked thickening and some deviation of the nasal septum, with very little free breathing space through the nose.

After some local treatment to the mucous membrane of the nares which relieved the congestion and chronic inflammation, a submucous resection was done in November, 1929. Since this operation the patient breathes through the nose and has had no recurrence of the chest symptoms.

Figure 4 is a reproduction of the roentgenograms of this patient.

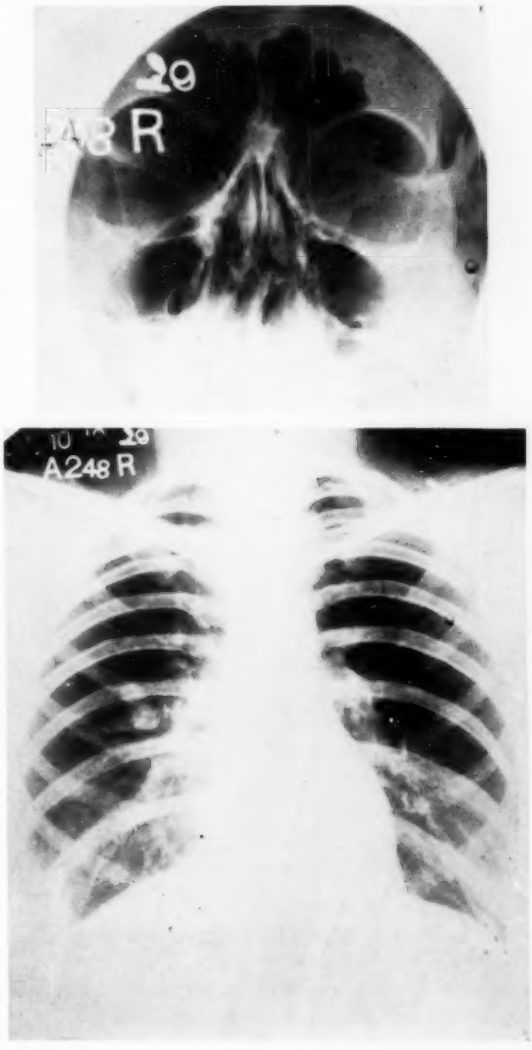


Fig. 4. Case III. The lung changes due to upper respiratory tract abnormality are quite marked. The sinuses show no evidence of pathology. The deviated septum, with bilateral nasal obstruction, is evident.

The fourth patient is from a group in whom the mastoids were the source of infection. The persistence of the cough over a period of five years made her a tuberculous suspect.

Case IV (8201). S. L., female, aged thirty-five, housewife, white, was admitted to the hospital on September 29, 1928, complaining of earache. She had been annoyed for the past four or five years with an occasional productive cough and stated that physicians have "suspected" her of being tuberculous. For the past five weeks the cough had been very annoying and had often kept her awake at night. There had been no pain in the chest at any time. Two days before, during the afternoon, she was seized with a severe pain in the right ear. The pain was intense throughout the night, and, in the morning, there were a few drops of pus in the external auditory canal. The ear condition was the reason for hospital treatment.

Physical examination revealed nothing in the sinuses, nose or throat that was abnormal. The tonsils were negative. The right ear canal was swollen and showed a hemorrhagic bleb

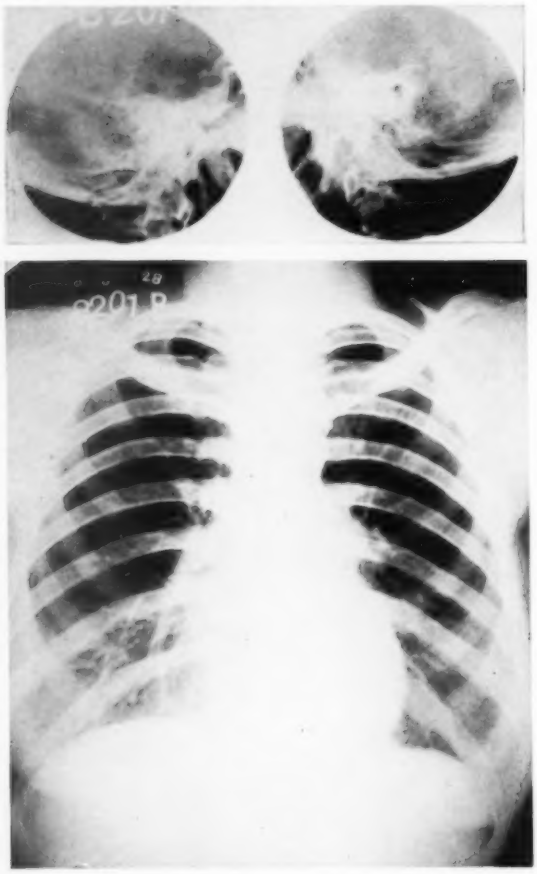

FIG. 5. Case IV. The lung markings in this patient are typical of upper respiratory tract infection or abnormality. The right mastoid (on the left) is diseased, showing an acute exacerbation of a chronic inflammatory process.

which bled easily. No adequate view of the drum was obtainable. The left ear was negative. The leucocyte count was 9,000, the urine showed a trace of albumin but no casts and was otherwise negative. Repeated examination of the sputum failed to reveal the presence of tubercle bacilli. On admission the temperature was 102° F. and the pulse 124 per minute.

On the eleventh day following admission, the right mastoid was opened. The surgeon's report was: "That right mastoid is wide; cells broken down at the tip and cavity filled with pus, a few soft cells close to antrum, otherwise cells very hard, but in places filled with congested lining." The patient was discharged from the hospital on the eighteenth eay. She made an uneventful recovery and four years after the mastoid operation has had no recurrence of the cough.

Figure 5 is a reproduction of the roentgenograms of this patient.

The fifth case is from a series in which the infection came from the tonsils. After tonsillectomy his addiction to repeated "coughs and colds" each winter has disappeared.

CASE V (A-469). C. J., male, aged twenty-nine, white, accountant, complained of repeated coughs and colds over a period of eight years before being sent to the hospital for roentgen examination of the lungs and sinuses (Fig. 6). During all of each winter he suffered

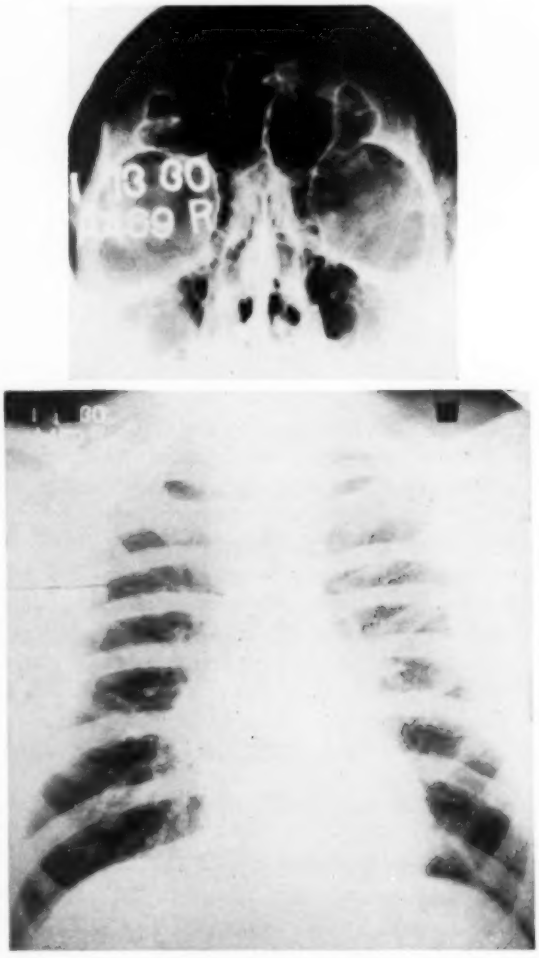

FIG. 6. Case V. The sinuses were considered clinically to be negative. The lungs show the typical markings of upper respiratory tract pathology. The bronchovascular tree is slightly more exaggerated in the upper lobes than is usually seen. The exciting cause in this patient was chronic tonsillitis.

from a severe, productive cough with loss of weight and strength, frequent elevation of temperature and malaise. These attacks of "colds" came on during the first cold days of winter and persisted until the warm days of spring.

He was not subject to sore throat and had had only the ordinary diseases of childhood. He had never had rheumatism, although during his youth he complained of "growing pains." There was no history of chorea or cardiac disease. Chest examination revealed a few scattered râles at both bases posteriorly.

Physical examination of the nose and throat showed the sinuses negative, the drums pale and glistening, no bulging. Nose negative. Sinuses transilluminated readily. Tonsils "four plus," large and red, from which purulent plugs were readily expressed.

Under local anesthesia the tonsils were removed January 17, 1930. The operation resulted in the complete relief of the symptoms at once. The patient has suffered no attacks of "colds" since. The cough stopped and he has gained 30 pounds in weight in the three years since operation.

The sixth patient represents a group in which there was definite infection in the sinuses but treatment for this infection did not clear up the lung symptoms. Further search for foci revealed another pathologic condition—infected tonsils.

Case VI (7050). D. S., female, aged twenty, white, student nurse, had measles and chickenpox during childhood but no other diseases, except acute appendicitis, until six years ago when she began to have repeated attacks of tonsillitis. During the past six years she had had many attacks of "sore throat" with "coughs and colds" coming on in the autumn and lasting until spring.

On October 22, 1927, the patient was admitted to the hospital with cough, malaise, sore throat and a "raw" feeling in the chest. During her stay of five days in the hospital, the temperature was subnormal, ranging from 97.8° to 98.4° F. The pulse ranged from 80 to 100 per minute. The blood examination was negative, and the urine examination practically so. Auscultatory respiratory sounds and percussion resonance were normal. The tonsils were large, very hard, normal in color, but showed a drainage of 60 per cent and were classed "two plus." Ear examination was negative.

She was readmitted on March 8, 1928, complaining of the same symptoms as on the previous admission. The cough had persisted during the entire winter with an occasional soreness of the throat and some nasal discharge. During this admission the temperature still remained below normal and the pulse ranged from 80 to 90 per minute. Urine and blood examinations were negative. The chest examination revealed no evidence of pathology in heart or lungs. The mucous membrane of the nose and throat was somewhat reddened and there was some thin secretion. The condition of the tonsils was not mentioned at this admission.

In order to rule out a possible pulmonary infection roentgenograms of the chest for lung detail were requested. No evidence of pulmonary tuberculosis was found but evidence of an upper respiratory tract infection was noted and reported. Roentgen examination of the sinuses was then made and chronic, bilateral maxillary sinusitis reported. The maxillary sinuses were irrigated and a small quantity of purulent meterial obtained from each.

From this time until November, 1928, the sinuses were given constant attention but the patient's condition, severe coughs and colds, persisted in spite of the fact that summer intervened since the last admission to the hospital. On November 4, 1928, she was again admitted to the hospital and, after the subsidence of the acute symptoms, the tonsils were removed. The surgeon's report was "badly infected tonsils." The patient has been well during the four years since the tonsillectomy was performed. She has had no recurrence of her "coughs and colds" and has gained 15 pounds in weight.

Figure 7 shows the reproduction of the roentgenograms of this patient.

The seventh patient in this report represents a group similar to that of the last patient. In this instance there was a definite infection of the left maxillary sinus, but the cause of the pulmonary changes was an infection of the mastoid. All pulmonary symptoms disappeared, when adequate drainage of the middle ear was established.

Case VII (A-751). W. J., Jr., male, aged nine, white, was admitted to the hospital May 26, 1930, on account of "fever of undetermined origin." For seven weeks previous to admission he had been confined to his home on account of

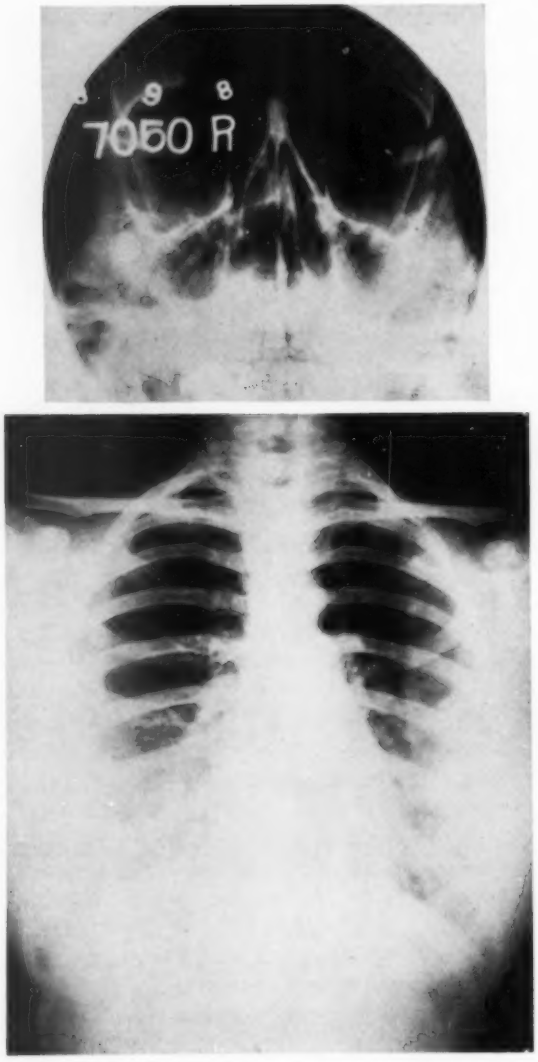


FIG. 7. Case VI. The upper lung fields are clear. The lower lobe markings are more pronounced than those usually seen in patients with upper respiratory tract abnormality. The sinuses show some chronic bilateral involvement, with the left side worse than the right.

moderate fever, cough, anorexia and listlessness. His daily afternoon temperature ranged from 101° to 103° F. During the course of the illness he developed measles which temporarily added to his disability but from which he recovered before entering the hospital. On admission his temperature was 102° F., pulse 110 per minute, and respirations 24 per minute. The urine showed a trace of albumin but no other abnormality. The leucocyte count was 15,200 cells. No differential count was made. The red blood cells numbered 4,800,000 and the hemoglobin was 86 per cent.

Transillumination of the sinuses was made with difficulty and the conclusions from the examination were not noted on the history. "Right ear negative, left ear negative except for a slight reddening of the drum. Tonsils, teeth, mouth and throat negative. The mucosa of the nose is slightly red and swollen but there is no evidence of pus." Roentgenograms of the

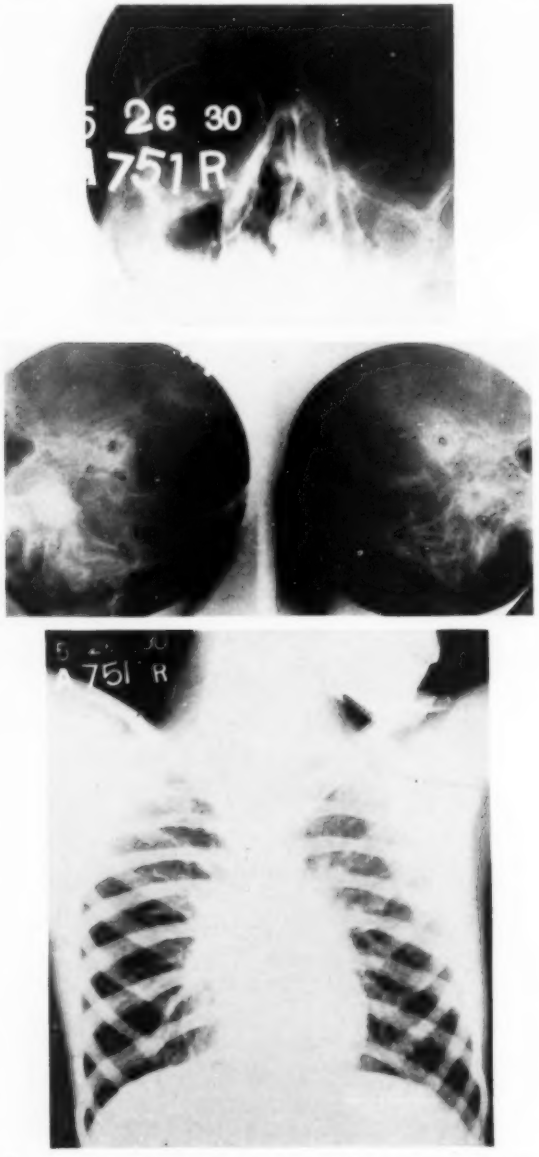


FIG. 8. Case VII. The evidence of upper respiratory tract abnormality, as shown in the lungs, is not marked in this patient. The left maxillary sinus is definitely involved. The left mastoid (on the right) is diseased.

lungs, sinuses and mastoids were made (Fig. 8). The left maxillary sinus, which showed marked haziness on the film, was irrigated. Three days after the operation the patient was allowed to go home, in spite of the fact that the ear condition had not cleared up and there were marked changes in the mastoid on the roentgenogram. His general condition had not improved. His symptoms continued for seven days. On the evening of the seventh day he complained of pain in the left ear. During the night the pain became more severe and was relieved by paracentesis. A few drops of pus exuded from the canal and drainage continued for several days. After treatment for the ear condition, the symptoms referable to the lungs subsided, the temperature dropped to normal and remained so. Convalescence was rapid.

This case is interesting because of the fact that both the attending physician and the surgeon felt that an infection of the sinuses only could account for the lung symptoms of which the child complained. They were of the opinion that treatment of the sinus infection would completely relieve the symptoms, and apparently disregarded the clinical and roentgenological findings in regard to the ear and mastoid.

## SUMMARY AND CONCLUSIONS

(1) Other conditions than acute and chronic sinus infection may cause symptoms referable to the lungs which may simulate pulmonary tuberculosis.

(2) These conditions, as well as sinus disease, may produce certain definite changes in the bronchovascular tree markings as revealed on the roentgenogram.

(3) These conditions are not all the result of infection, but may be due to malformation or other abnormality.

(4) Failure of relief from eradication of one abnormality or infection necessitates search for another possible cause.

(5) The pulmonary changes, as noted on the roentgenogram, do not clear up following therapy, but probably persist for years.

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# THE RELIEF OF PAIN BY ROENTGEN IRRADIATION IN PAGET'S DISEASE OF BONE

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MOST of the articles on Paget's disease of bone in the recent American and British literature deal with the diagnosis and differential diagnosis, and do not mention treatment. Some authors frankly state that the treatment is not known,[7] or that it is unsatisfactory.[10,12] One author[8] treated with neoarsphenamin and gluteal injections of mercury a case of Paget's disease of the skull which had severe pain, blurring of vision and elevation of temperature, and obtained a marked relief of symptoms. Another writer[15] reports that treatment with parathyroid extract (Collip) gave great symptomatic as well as objective improvement, as demonstrated by roentgen examination. There is also a report[9] of the union of pathological fracture in a case of Paget's in which it was thought that healing was aided by treatment with thyroid extract, phosphorized cod-liver oil, and calcium lactate. Another author[3] reports that in 16 out of 18 cases, the administration of adrenal cortex hormone with a high calcium diet gave marked relief from pain, restoration to occupational activity, and an apparent arrest of the disease. He feels that these results "justify the conclusion that adrenal cortex hormone is a valuable remedy for a disease which has hitherto had no remedy at all." In a careful study of the therapy of Paget's two authors[2] advocate the use of calcium lactate, viosterol and tomato juice, taken when the digestive tract is empty in order to favor absorption. Treatment with parathyroid extract, according to these authors, gave no relief, or provoked an exacerbation of symptoms. Three articles were found in the British literature in which the authors [11,13,14] report that ultraviolet radiation in ordinary dosage gave relief of pain in Paget's disease with regeneration of bone as shown by the roentgenogram. Two of these authors combined this therapy with calcium medication, and one added parathyroid extract. Several authors[1,4,5,6] report the use of roentgen therapy for patients in whom sarcoma is associated with Paget's disease. Some of these patients obtained relief, others did not. All of them died within a short time from the malignancy. No report was found in which roentgen therapy was used for the relief of pain in Paget's disease of bone uncomplicated by sarcoma.

In December, 1927, on his return from Vienna, Dr. J. B. Eyerly, of our hospital staff, brought the verbal report that roentgen treatment is used in the Eiselbach Clinic for relief of pain in Paget's disease. I have followed this recommendation in 4 cases which I wish to report. The following routine dosage has been used at each treatment: 5 ma., 140 kv.p., 0.25 mm. copper and 1 mm. aluminum filter, 10 inch skin target distance, time 10 minutes, covering an area 15 cm. in diameter. This dosage gives 35 r per minute.

## CASE REPORTS

CASE 1. R. B., male, aged forty-nine, in July, 1927, complained of pain of two weeks' duration in the right shoulder and upper arm, which started abruptly after playing a game of handball. The pain was aching in character and at times sharp and severe, especially on certain motions, such as putting on a coat. There was no evidence of other illness, no elevation of temperature, and no loss of weight. There were no abnormal findings on physical examination.

The roentgenogram of the humerus showed a sclerosing process which involved the upper half of the shaft, with thickened cortex, pronounced trabecular markings and several areas of lessened density, especially in the region of the head. Because of these findings all other bones of the body were roentgenographed, but no evidence of bone change could be found elsewhere.

In the differential diagnosis, Paget's disease of one bone, a low grade osteomyelitis, and

tumor were the three diseases most considered. The absence of fever or redness of the arm seemed to rule out osteomyelitis. Tumor seemed unlikely with no loss in weight, no evidence of a soft tissue swelling, and no break in the cortex or localized expansion of the shaft as seen in the roentgenogram. The final decision was in favor of Paget's disease.

The symptoms persisted intermittently for ten months before any roentgen therapy was given.

A roentgen treatment was given April 21, 1928, to the upper part of the humerus, laterally, and on May 1, anteroposteriorly, at which time the patient stated that his arm felt better. The third treatment, on May 8, 1928, was given to the humerus posteriorly. This relieved the pain completely, and treatment was discontinued.

Two years later pain recurred, and subsided after two roentgen treatments, March 21, and April 18, 1930. A year later, April 17, 1931, one more treatment was given for a slight recurrence of the pain.

On July 29, 1933, five years after the onset, the patient stated that there was no pain, and that the arm had not troubled him for a long time. At no time was any other type of medication given. Subsequent films show no appreciable change in the bone.

Case II. V. D., male, aged forty-one, was in the hospital June 18–20, and on August 12, 1929. He complained of aching pain in the hips for the past two years. Five months ago this extended to the right leg and became sharp and severe with exercise. Stiffness, apt to be present in the morning, was relieved by a hot bath. When seated, or in bed, he was perfectly comfortable. The pain in the hip was not incapacitating, while that in the leg was. A true sciatic pain never was present, nor pain down the posterior surface of the thigh. In all other respects this patient's history and findings were normal.

A roentgenogram of the right femur showed a marked sclerosis and prominent trabeculation in the upper two-thirds of the shaft, including the head and neck, with an increased width of the cortex, and some areas of lessened density in the shaft. There was no involvement of any of the other bones. The diagnosis of Paget's disease was made.

The patient was given cinchophen for the pain, and later calcium lactate and glucose, which he took for two weeks, and then stopped because he felt it gave him little or no relief.

On August 12, 1929, when he re-entered the hospital for one day, the record states that the patient was more comfortable than formerly.

A week later, August 18, 1929, this patient was referred for roentgen therapy. His pain was so severe that he walked with a cane. After two roentgen treatments, August 19 and 26, directed to the right upper femur anteriorly and laterally, the patient stated that the pain was less and he could walk without his cane. Treatments were given on September 6 and 10, and when he returned for treatment on September 19, the patient said he had been walking and dancing a good deal for a week. On November 7, after four more treatments, the patient said he had no more sharp pain, and very little difficulty of any sort. On April 23, 1930, after a total of nineteen roentgen treatments this patient stated that he was feeling fine, had no pain, was able to ride a horse, drive a car, dance or play thirty-six holes of golf without discomfort.

In August, 1932, the patient saw Dr. Winthrop Pennock, Syracuse, N. Y., who roentgenographed him again, and wrote for his roentgen films and treatment record. He reported a slight exacerbation of film findings in right femur, and no change in other bones, and due to the good result obtained previously he felt that more roentgen therapy was indicated. In a letter dated August, 9, 1933, the patient states that he has had no recurrence of symptoms in four years, and that at present he is in excellent health.

Case III. C. E. W., male, aged sixty-seven, was in the hospital from September 12–17, 1929, with the history and findings of an obstructive jaundice of five or six weeks' duration, and a severe hypertension of twelve years' duration. Of importance, as far as this paper is concerned, is the history of an aching pain, weakness and tired feeling in the left leg which began after an injury twenty-five years ago. Several years after the onset the left leg became bowed, and the patient began to limp. The trouble was never sufficient to prevent walking. No other deformity. Swelling, stiffness and extensive hemorrhage have been present in the left leg following an accident two or three years ago, and since that time there has also been an aching pain and weakness in the right leg. Physical examination showed a for-

ward bowing of the left tibia, ankylosis of the patella, and large irregular exostoses about the knee and lower end of the femur. Small cartilaginous bodies were palpable under the skin over the patella, and around the knee. Similar, though less marked changes, were present in the right leg. The right patella was irregular, but not ankylosed.

The roentgenograms showed the characteristic and very marked changes of Paget's disease, involving the bones of the left side of the pelvis, lower left femur, and left tibia, with marked involvement about the left knee, and a similar, though less marked, involvement of the upper right femur. Very little if any change in the skull.

The patient was referred for roentgen therapy, and three treatments were given in February, 1930, to the left knee, tibia and ankle. At the same time this patient was given karo syrup ½ oz. with calcium lactate gr. 30 t.i.d. for two weeks in each month.

On April, 1930, the patient reported his general condition better, with pain somewhat relieved, especially in the morning, but worse in the afternoon or evening. In August the pain was increased by a long walk and an auto ride. In November, he stated that the pain was troubling only moderately, and his general condition was good. He was, as on previous occasions, advised to return for more treatment, which at that time he accepted. Accordingly, four more treatments were given in November, 1930, to the left knee, tibia and ankle, and the calcium lactate therapy was also resumed at that time.

In February, 1931, the patient reported that he had very little pain, and again in October there was no complaint. In November he had an extensive cutaneous rash, but there seems to have been very little complaint of pain in the left leg at that time.

Our next record is that on October 12, 1932, this patient died suddenly while driving a car.

CASE IV. J. F., male, aged sixty-nine, was in the hospital March 12-15, 1929. The patient dates the onset of his trouble to an auto accident sixteen years ago in which he was thrown from the car and landed on his left side. There was bruising and swelling of the left leg and side, and in the left axilla. No fracture was ascertained at the time. There have been recurrent attacks of pain in the region of the injury ever since. These attacks have been gradually growing more severe, and more frequent. The pain, which began in the dorsolumbar region and radiated to the front and over the left side of the abdomen, was aching in character or sharp and burning, and sometimes severe enough to put him to bed, once for a month. Recently, with a recurrence of pain, there was also a feeling of numbness which started in the left buttock, and extended down the left leg to the foot.

On examination the patient was tender on pressure in the regions described. The left tibia was bowed anteriorly, and thickened. The left leg and foot were slightly swollen and "numb" to the touch. The right leg was normal. No other abnormalities were noted.

The roentgen films, made elsewhere, showed a wedge-shaped compression of the second lumbar vertebra, interpreted as an old fracture, and also the typical changes of Paget's disease of bone, involving the ilium and tibia. No skull change.

The patient was given sodium salicylate and soda bicarbonate for pain, and also calcium lactate grains 30 after meals, and karo syrup drachms 4 between meals. In addition the patient was referred for roentgen therapy and one treatment was given to each of the following areas: on March 12 to both the upper and lower half of the left tibia; on March 14 to the left groin, and the lower posterior half of the left tibia; and on March 15 to the left hip laterally.

After the first two areas were irradiated the patient said that the left leg felt more comfortable. During the trip home to South Dakota he had almost no pain, and in July wrote that he had no acute pain, and only a dull aching pain and slight swelling around the left ankle when compelled to be on his feet more than usual. He returned to Chicago, and on August 13 one treatment was given to each of the first and second areas. Late in 1932 he reported that he was feeling fine.

## SUMMARY

In four cases of Paget's disease of bone roentgen therapy alone, and in conjunction with calcium lactate and glucose, has given good results. I am glad to report these cases as an extension of the use of roentgen therapy to a disease which under other forms of medical treatment has usually not yielded.

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# PRELIMINARY OBSERVATIONS CONCERNING THE EFFECTS OF ROENTGEN IRRADIATION IN THE PRESENCE OF FLUORESCEIN

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THE increased biological effect of electromagnetic waves in the presence of certain pigments and dyes has been noted for many years. The common example is the increased sensitivity to light of individuals whose blood contains hematoporphyrin.

Noguchi[6] in 1906 noticed the increased action of light on plant cells, *Paramecium* and sperm in weak solutions of eosin. Further observations, notably the sensitizing of proteins to light in artificially fluorescent substances, such as eosin and fluorescein, were reported by Sellards.[8]

Attempts to increase the biological and selective action of roentgen radiation by its use in conjunction with other agents are legion. A few, apparently, have been significant. Mottram[5] reported on a series of experiments with rat sarcoma. From these he concluded that the summation of roentgen irradiation plus certain aniline dyes had a greater biological effect than either of these agents alone. Supplementing Mottram's experiments, the work of Copeman, Coke and Gouldesbrough,[2] in 1929, and of Copeman,[3] in 1931, indicated that weak alkaline solutions of fluorescein increased the effect of roentgen irradiation in certain types of malignancies such as ulcerating carcinomas of the breast and metastatic glands. Their observations did not include deep-seated malignancies. Colwell,[1] using oral and local administrations of a weak solution of fluorescein, concluded that any added beneficial effect in this type of treatment was due to the slight bactericidal action of the dye.

Treatment by this method was first used by us in February, 1931. This was done more or less empirically one month after a full cycle of deep roentgen irradiation had been administered without perceptible effect on the growth. Treatment factors were 200 kv., 4 ma., 0.5 mm. of copper and 1.0 mm. of aluminum filter with a total dosage of 860 r; effective wave length 0.16Å (Duane's method). The case was a middle-aged, white, female patient with a large mass in the left supraclavicular area. Biopsy of this mass was reported as metastatic adenocarcinoma. No primary lesion could be found. Following the technique suggested by Copeman and his coworkers,[2] the mass was injected with a weak solution of fluorescein, immediately followed by roentgen irradiation. Factors were as follows: 110 kv., 5 ma., 4 mm. of aluminum filter, with a dosage of 300 r at one sitting; effective wave length 0.35Å. This treatment was repeated at weekly intervals for three treatments. A month later a definite reduction in the size of the mass, decrease in pain and improvement in the subjective symptoms were noted. Observation and treatment when necessary were carried out during the next year and a half with no perceptible increase in the progress of the condition. This patient was carrying on her usual daily routine with no complaints in June, 1933.

At one time during the treatment of this patient it was observed that she had developed an erythema in areas corresponding to the areas on which some of the fluorescein had been spilled during injection of the mass.

In an attempt to convert this observation into tangible evidence, a mixture of paraffin and weak solution of fluorescein was cooled and blocked. A small ionization chamber was fitted tightly into the block 1 cm. beneath the surface. A plain paraffin block of similar size was used as a control.

Repeated readings showed an average increase of 8 per cent in the ionization rate in the paraffin-fluorescein mixture as compared to the control. The roentgen factors used were 110 kv., 5 ma., 30 cm. surface target distance and no filter. This procedure was repeated using 200 kv., 4 ma., 0.5 mm. of copper and 1 mm. of aluminum filter, with the same surface target distance. No perceptible difference in the ionization rate was noted. Interposing 10 cm. of plain paraffin between the chamber imbedded in the paraffin-fluorescein block and using 200 kv., 0.5 mm. of copper and 1 mm. of aluminum filter, other factors remaining constant, showed some 4 to 6 per cent greater ionization rate with the chamber imbedded in the paraffin-fluorescein block.

It was our opinion that these phenomena were due to increased scattering and could be explained by well-known principles of roentgen-ray physics as follows: (*a*) that the moderately soft radiation exerted a greater ionization effect in a thin layer of scattering substance due solely to its absorption in a thin layer of this substance; (*b*) that a softening of the radiation during its passage through a scattering substance accounted for the results obtained with 200 kv. through 10 cm. of plain paraffin plus 1 cm. of paraffin-fluorescein. That such a softening occurs in passage through substances has been well demonstrated by Quimby and McNattin.[7]

The second case was treated first in March, 1932. This case was a huge, inoperable, abdominal tumor which was radioresistant after a full cycle of roentgen irradiation: 200 kv., 4 ma., 0.5 mm. of copper and 1 mm. of aluminum filter. Total dosage of 860 r in two weeks, effective wave length 0.16 Å. Report of biopsy endothelioma. Roentgen irradiation with the factors just given was now used immediately following the intravenous injection of 20 c.c. of an alkaline 5 per cent solution of fluorescein. The patient was given a total of 1,500 r over a period of five weeks. Single treatments from time to time during the next year were given as indicated immediately after fluorescein injection, administering 300 r per sitting. In November, 1933, the tumor showed 75 per cent reduction in size, the patient being symptom-free.

In a series of 6 cases of Hodgkin's disease, with a diagnosis by biopsy or autopsy, who were given roentgen irradiation, one patient is living after three years. This patient was treated by the combined intravenous fluorescein-roentgen irradiation method. Other cases too recent to merit more than mention include one case of myelogenous leukemia in whom the usual response to roentgen irradiation alone failed after three months; one case of scirrhous carcinoma in a patient who refused operation, and one case of extensive inoperable sarcomatous involvement of the pleural cavity in a child. These cases are under observation at present.

The introduction into the body of fluorescein by any method causes a yellow discoloration of the skin and sclerae. No other signs or symptoms have been noted in any of our cases.

We have intentionally omitted any classification of tumors as to radiosensitivity. A survey of the literature shows that there is no unanimity of opinion on this subject (see Evans[4]).

## CONCLUSIONS

It appears that fairly soft radiation exerts an increased ionization effect in a scattering medium containing small amounts of fluorescein.

In the small numbers of cases observed over a significant period of time we believe these preliminary observations tend toward the conclusion that small amounts of fluorescein in malignant tissue decrease its resistance to roentgen irradiation.

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Vol. 34, No. 3

# IRRADIATION IN CARCINOMA OF THE LIP

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IN THE treatment of carcinoma of the lip the interesting question is presented as to whether surgery or irradiation, separately or in combination, should be the method of choice. The surgical procedure usually employed is a V-shaped excision of the local lesion or a radical resection of the lip and a unilateral or bilateral resection of the neck nodes. By the irradiation method the local lesion is treated with radium applied locally or directly into the tumor mass, while in some instances treatment is by roentgen irradiation. In either case, the regional lymph drainage areas are included in the scope of irradiation.

Sometimes cauterization of the local lesion with irradiation of the neck nodes is the method employed, and occasionally irradiation is applied only after the local lesion and the associated neck nodes have been surgically removed.

In order to evaluate and compare the relative advantages of surgery and irradiation, it is convenient to divide the cases into two groups, according to whether or not palpable nodes are present.

In those cases without nodes, simply local excision of the lip lesion has, in most instances, proved inadequate because of the predisposition of the entire lip to cancer, leading to frequent local recurrences and the eventual development of metastatic nodes. With radical surgical removal in such cases, however, recurrences are much less likely to occur. Brewer,[1] in 1923, in a review of surgical statistics, including those of Bloodgood, Beckman, Sistrunk, as well as his own, reported 66 per cent five year cures after simple local excision, and a five year cure of 92 per cent after radical operation. But equally good results are obtained without resorting to such radical procedures, according to the statistics of the radiation therapists. Table 1 illustrates, in general, the comparative results of surgery and irradiation.

In the second group of cases, where palpable nodes already exist, a large percentage are immediately withdrawn from the scope of surgery, being inoperable, because the malignant process extends through the capsules of the glands. Although actual cure by irradiation is not contemplated in such cases, much can be done in the way of palliation and inhibiting the progress of the disease for varying periods of time.

TABLE I

FIVE YEAR CURES

| | | No Metastasis | | Metastasis Present |
|---|---|---|---|---|
| | Up to 1.5 cm. | 1.5–3 cm. | Over 3 cm. | |
| Kennedy[4] | 88% | 67% | 44% | 34% |
| Brewer*[1] | ← | 92% | - - - - - - - - - - - → | — |
| Pfahler and Vastine[6] | 99% | ← - - - - - 85 % - - - - - - - → | | 56% |
| Duffy[2] | ← - - - - - - - | - - - 90% - - - | - - - - - - - - - → | — |
| Martin[5] | ← - - - - - - - | - - - 96% - - - | - - - - - - - - - → | — |

* Shows surgical statistics of author, Bloodgood, Beckman and Sistrunk.

It is unfortunate that statistics are not uniform as to results in lesions of similar size so that a better comparison and analysis could be made. However, this table illustrates in general the results obtained with surgery and irradiation.

In the remaining cases of this group, where operable nodes are present, there is the greatest divergence of opinion as to the proper type of treatment to be employed, for not all palpable lymph nodes are malignant. Shedden[7] found palpable nodes in 68 per cent of his cases, and of these only 20 per cent were malignant. Kennedy[4] reported that of the 60 per cent of his cases that had palpable cervical nodes only 33 per cent were cancerous. It is of interest to note that only about 25 per cent of the clinically diagnosed malignant nodes prove to be such histologically. On the other hand, in cases not presenting grossly palpable nodes only 10 per cent are involved with malignancy at the time of routine neck dissection.

Since there is no definite procedure to determine by external processes whether palpable nodes are malignant or merely inflammatory, surgeons contend that radical operation is warranted because it eradicates the disease if the nodes are involved, and eliminates a potential disease-bearing area if the nodes are only inflammatory. In the opinion of the radiation therapist, however, the small incidence of positive pathology does not justify so radical a procedure, with its concomitant operative mortality and mutilation and long period of hospitalization, especially as this 25 per cent occurrence of metastatic nodes can be otherwise satisfactorily attacked.

The following report is a study of 93 cases of carcinoma of the lip treated from 1925 to 1933 in the Radiation Therapy Department of Bellevue Hospital. Twenty-nine additional patients are excluded from this report because they either did not return for completion of treatment or did not report for one follow-up. From the economic standpoint these cases were principally of the poor, uneducated class, as well as of the shifting vagabond group found attending a free municipal hospital. For this reason adequate, long-period follow-up in this type of patient is practically impossible.

*Age Incidence.*

| Years: | 21–29 | 30–39 | 40–49 | 50–59 | 60–69 | 70–79 | 80–82 |
|---|---|---|---|---|---|---|---|
| No. of Cases: | 3 | 10 | 24 | 26 | 22 | 7 | 1 |

The youngest was twenty-one and the oldest eighty-two.

Seventy-seven cases, or 83 per cent, were of the ages forty to seventy.

*Sex.* Males were more frequently involved than females. Only 3 (3.2 per cent) cases occurred in women. Frickles reported an incidence in women of 9 per cent; Pfahler and Vastine,[6] 12 per cent; Simmons,[8] 12.5 per cent.

*Etiology.* From a study of these cases we are of the opinion that chronic irritation is a factor in the etiology of cancer of the lip. A history of excessive smoking was obtained in 78 per cent of the cases, and most of the lesions occurred on the site where the cigar, cigarette or pipe was held. Other etiological factors elicited were irritation by sharp teeth, or the habit of biting the lip. Ten per cent reported a single trauma or accident such as accidental burning of the lip with a cigarette, or a blow or a cut by some sharp object as the exciting cause. In 6 per cent, the carcinoma was present on a leucoplakia area, and these cases had similar patches on several areas of the mucous membrane. The Wassermann reaction was positive in only 6 of the 69 instances where it was taken.

*Size of Lesion.*

| Less than 1.5 cm. | 1.5–3 cm. | Over 3 cm. |
|---|---|---|
| 44 | 29 | 15 |

In 5 cases the local lesion was removed previous to admittance for irradiation. In some instances the lesion was quite ex-

*Duration of Lesion.*

| 1–6 mo. | 7–12 mo. | 1 yr. | 2 yr. | 3 yr. | 6 yrs. | 10 yr. |
|---|---|---|---|---|---|---|
| 33 | 19 | 24 | 11 | 3 | 2 | 1 |

tensive. In 12 cases one-half the lip, and in 3 the entire lip, was involved.

In 41, or 44 per cent, of the cases the lesion had existed over one year. In most instances, there was a definite correlation between the size of the lesion and its duration, and the infiltrating type showing slower development.

*Types of Lesions.* Cancer of the lip occurred in two distinct forms: the infiltrating and the papillary type. In the former, there was a central ulceration surrounded by a raised, indurated border. Growth was relatively slow, and excision was often followed by recurrences, since the whole lip is predisposed to cancer. Metastases were more frequent in this group. The papillary type consisted of a flat, wart-like growth or a fungating mass which spread rapidly and widely, but less dangerous than the infiltrating form.

*Nodes.* In 11 cases, or 12 per cent, there were grossly palpable metastatic nodes, which we believed were malignant, and 4 cases developed nodes while under treatment.

*Treatment.* The form of treatment, as employed in our clinic, has been developed over a period of ten years as described by one of us (Kaplan[3]). Treatment is begun by external irradiation of the lymph glands of both sides of the neck, regardless of whether the lesion is on the right or left side of the lip. (For this, high voltage roentgen therapy is employed, using 200 kv., 4 ma., 0.5 mm. copper, and 1 mm. aluminum filtration, at a 30 cm. distance.) The usual dosage is 200 r given daily for a total dose of 800 to 1,200 r to each side.

During the course of the local treatment the patient is hospitalized. In the earlier years, interstitial radium therapy with removable platinum needles was employed, but more recently, a wax mold containing radium tubes is being utilized. The mold is made of dental wax 1–2 cm. thick, is fitted to the entire lip, and is made to extend beyond the chin for fixation. The mold is so constructed that the lip is pulled outward and downward, and in this position the lesion can be cross-fired from above, below and anteriorly. It also draws the irradiated site away from the upper lip and obviates the need for protective devices. Radium in the form of tubes, filtered through 1 to 1.5 mm. platinum, is imbedded on the outer surface of the mold, and so distributed as to surround the periphery of the lesion.

This treatment requires hospitalization for a period of three to five days, during which time the mold is held in place continuously except during meals. There is little or no discomfort. The dosage given is 1,200–2,000 mg-hr.

In ten to fourteen days a typical radium membrane forms at the irradiated site and at this time the patient may complain of a burning sensation in the lip. If severe enough, it may be alleviated by wet boric acid compresses and bland soothing ointments. The radium membrane then gradually diminishes, and is replaced by a smooth white soft scar. This process takes from two to four weeks, and usually during this period there are no symptoms or complaints.

The deformity that remains will depend upon the extent of the original destruction of the lip; thus, in the papillary type where there is little infiltration, the healed-over area can seldom be distinguished from the normal lip. In the ulcerative type, a depression will in most instances persist after healing has taken place.

When the local lesion has entirely healed, a prophylactic series of high voltage roentgen therapy is given to both sides of the neck.

In those cases with metastatic nodes, larger doses of roentgen rays are employed or irradiation is given with the 5 gram radium pack. With the latter, 50,000 to 60,000 mg-hr. is given in divided doses at daily intervals. If, with this mode of attack, a total disappearance of the nodes does not occur, the residual nodes are treated either with gold radon seeds or removable platinum radium needles. With this type of therapy there may be com-

plete eradication of the malignancy or, at any rate, the further growth of the nodes is definitely checked.

*Results.* The results in the 93 cases studied depended upon the presence or absence of nodes in the cases treated.

Group I: Included in this group are 82 cases, with no palpable nodes on admission. Of this group, 5 developed local recurrences in the form of simple small non-indurated ulcerations, which were easily treated with small topical radium applications, and have remained healed for two, one and a half years, respectively. One case showed an entirely new growth on the opposite side of the lip. This was treated with a radium mold, and has remained healed now for one year. In one case, the recurrence was at the site of the original lesion and of the same size. Following subsequent treatment this has remained healed for six months.

There were 4 patients who, after admission, subsequently developed nodes. Three of these patients have died from the disease; in one, the node involvement has remained stationary now for nine months.

The age of the patient and the size and duration of the lesion are of no significance in explaining the occurrence of the metastases. It is our opinion, therefore, that even the small superficial lesions should have adequate intensive therapy to both the local and the lymph drainage area.

The remaining 73 cases, without subsequent recurrences or metastases, were observed for the following period:

| | 1 yr. | 2 yr. | 3 yr. | 4 yr. | 6 yr. | 6 yr. | 7 yr. | 8 yr. |
|---|---|---|---|---|---|---|---|---|
| No. Cases | 34 | 16 | 12 | 3 | 5 | 0 | 2 | 1 |

It is more than possible that the record of the number of five year cures would be greater had we been able to secure a better follow-up in the cases. We have been forced to use the frequency and number of local recurrences and glandular metastases as an index to our success in treating the original condition, as we found that patients would return as soon as recurrence developed but were reluctant to return if the lesion remained healed.

Group II: Eleven cases had palpable lymph nodes on admission. We found no age group more susceptible to metastases. In 5 cases having no visible lesion previous surgical removal had been effected. Tables

TABLE II

| Duration of Lesion: | | 1–3 mo. | 3–6 mo. | 6–12 mo. | 1 yr. | 2 | 3 | 6 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| Group I | No nodes on admission | 8 | 24 | 17 | 20 | 9 | 3 | 1 | 0 |
| Group II | Nodes on admission | 0 | 1 | 2 | 4 | 2 | 0 | 1 | 1 |

TABLE III

SIZE OF LIP LESION: ON ADMISSION

| | No lesion | Less than 1.5 cm. | 1.5–3 cm. | Above 3 cm. |
|---|---|---|---|---|
| Group I | 0 | 43 | 29 | 10 |
| Group II | 5 | 1 | 0 | 5 |

II and III illustrate that, in most instances, metastatic nodes were found in the extensive lesions of long duration.

In cases of Group II the following results were obtained:

1. Two cases, which have been followed for six years and one year, respectively, have both local and metastatic lesions apparently cured.

2. In 2 cases the local lesions have healed, but the nodes have not completely regressed. These cases have been followed for one and two years, respectively.

3. One patient had recurrence in the scar of the previous bilateral neck dissection and, although extensive, this process has been arrested with irradiation, for six months.

4. The remaining 6 cases had constant progression of the disease with fatal outcome for all.

## SUMMARY AND CONCLUSIONS

1. An analysis of 93 cases of cancer of the lip treated in the Radiation Therapy Department at Bellevue Hospital from 1925 to 1933 is presented.

2. In this series males were much more frequently involved than females (97 per cent).

3. Carcinoma of the lip was most commonly frequent between the ages of forty to seventy years (83 per cent).

4. Chronic irritation was an important factor in the etiology. A history of excessive smoking was obtained in 78 per cent of the cases. A positive Wassermann reaction was present in less than 1 per cent of the cases; 50 per cent of the cases had lesions over 1.5 cm. in size and 44 per cent over one year in duration.

5. Of the 82 cases admitted without metastatic nodes, 88 per cent have remained well without local recurrences or metastases and 95 per cent without regional metastases. Four patients developed metastatic nodes and 3 of these have died.

6. Metastatic nodes were present on admission in 11 cases, 6 cases had progression of disease and died. Two cases have been apparently cured for six years and one year respectively. In the remaining cases the process has been arrested for six months, one year, and three years.

7. In general, the results of irradiation compare favorably with those following radical surgery, with the added advantage of no immediate operative mortality; moreover, mutilating scars are very much less likely to occur following irradiation.

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# GIANT CELL TUMOR OF THE SPINE

## WITH REPORT OF A CASE

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RECENT study of a case presenting an unusual destructive process in the first lumbar vertebra, diagnosed as a giant cell tumor, has stimulated my interest in this rare bone lesion. When this tumor is seen in its common location in the epiphyses of the long bones it is usually identified without great difficulty but when it appears in an uncommon area, especially in the spine, it presents a much more complicated diagnostic and therapeutic problem.

Nélaton's communication in 1860 is generally credited with being the first publication dealing with giant cell tumor. I have been able to find in the literature 45 case reports of giant cell tumor of the spine. The first was that of Rodgers[17] in 1903. In 1924 Lewis[12] published the collected records of 16 cases and added one of his own. There followed in chronological order Coley[5] (1924) 3 cases; Adson[1] (1928) 2 cases; Cotton[6] (1928) one case; Bower, Clark and Davis[4] (1930) 29 cases—one being their own and 28 collected from the literature, 13 of which have not been found elsewhere; Santos[18] (1930) 5 cases, one personal and one not found elsewhere; Meyerding[13] (1930) one case; Kirklin and Moore[11] (1932) 2 cases; and Pierce[15] (1932) 2 cases.

### ETIOLOGY AND PATHOLOGY

The majority of observers now consider benign giant cell tumor as an abnormal variation of the process of repair and not a true neoplasm. It is therefore closely related to single bone cyst and osteitis fibrosa cystica. Geschickter and Copeland[9] have written in detail concerning the etiology, pathology and relationship of these lesions and have formulated a logical background for their further study. Their theory, briefly stated, is as follows: New bone formation persists in the child and young adult in the epiphysis and in the diaphysis adjacent to the epiphyseal line. In this zone new bone is preformed in cartilage and later replaced by permanent bone. As a vital part of this transformation, mesenchymal cells agglutinate to form giant cells or osteoclasts. These cells perforate the perichondral bone and open channels for new capillaries and osteoblasts. At the height of the resorptive process, the giant cells are so numerous as to make the microscopic picture that of a giant cell tumor. The constant occurrence of bone cysts on the metaphyseal side of the epiphyseal line and of giant cell tumors in the epiphysis, at the ages when intracartilaginous bone is being formed, links both these lesions with the process of resorption. The truth of this is strikingly substantiated by the fact that giant cell tumors of the skull occur only in those few bones which are not membranous in origin but are formed from cartilage by resorption.

Trauma is undoubtedly the first step in the development of giant cell tumors and cysts. Violence damages the periosteum, causes the formation of subperiosteal hematoma and interrupts the periosteal blood supply of the cortex. The medullary blood supply can overcome the resulting deficiency only as and when osteoclasts open up new channels in the bone for the passage of budding capillaries. Thereby an additional osteoclastic activity is superimposed upon that already going on, as a part of normal bone conversion, with a resulting imbalance between destruction and production. Because the defense reaction of the cortical bone has been impaired by the interruption of its blood supply, an unchecked hyperplasia of the osteoclasts builds a tissue which is the forerunner of both giant cell tumor and early bone cyst.

If this hyperplasia occurs in the metaphysis the thick cortex, with a medullary blood supply, is eventually able to check the destructive process and attempt repair in the form of bone cyst. If, however, it occurs in the epiphysis, which has little blood supply other than periosteal, the thin cortex offers poor resistance and the hyperplasia progresses more rapidly with the formation of a giant cell tumor. Geschickter and Copeland[9] then apply the terms "regressive osteoclasia" to the process which results in bone cyst, and "progressive osteoclasia" to that which produces giant cell tumor. It would seem, therefore, that giant cell tumor is not a true neoplasm and should occur only in those areas where cartilage is being converted into bone. The age incidence, location, clinical course and response to treatment seem to substantiate this conclusion.

The macroscopic picture of giant cell tumor is that of a lesion primarily destructive. It is subcortical in origin, with the cortex expanded and reduced to a thin shell, sometimes intact but often perforated in one or more places, and in some cases completely destroyed. The tumor varies in color from gray to a dark red (often described as "currant jelly"), is very friable and bleeds easily when touched. The mass is often enclosed in a fibrous sheath from which fibrous trabeculae extend toward the center. The fibrous proliferation is a defense reaction which is heaviest on the cortical side but may sometimes be seen grossly in the area of cancellous bone.

Microscopically the benign giant cell tumor is composed largely of a stroma of spindle and small round cells with the round cells predominating. Crowded into the stroma are numerous giant cells with many dark staining nuclei of the same form as the surrounding round cells and evidently formed by their agglutination. These are the "foreign body giant cells" of Mallory (whose function is the absorption of calcium containing tissue), as contrasted with the smaller, less numerous giant cells, with fewer, lighter staining nuclei, which are associated with osteogenic sarcoma and other malignant neoplasms. Scattered through the mass of the tumor are newly formed blood vessels, many free red blood cells and areas of organizing hematoma. Near the periphery are small fragments of old bone being destroyed and islands of new bone being formed. Around the old bone the giant cells are numerous and about the new bone osteoblasts predominate. The spindle cells adjacent to the new bone and distributed through the round cell stroma are surrounded by fibrils and are fibroblasts concerned with the process of repair.

Geschickter and Copeland[9] describe a "spindle cell variant of giant cell tumor" in which a section shows an area of giant cells, a border of spindle cells, a zone of osteitis fibrosa and a region of proliferating cortical bone—clearly a healing reaction. In their series of 226 giant cell tumors, 37 showed this variant. Twenty-nine were in the small or flat bones and 8 were in the spine. None occurred in the long bones. The clinical course of these cases demonstrated an unusual tendency toward healing; only one died from the tumor and that one following an unsuccessful operation in the sacral region. There were no recurrences in the group, whereas 20 per cent of typical giant cell tumors recur following similar treatment. Such a healing reaction in the small bones is explained on the ground that early in its development the tumor meets on all sides the decisive defense of cortical bone. Tumors having the "spindle cell variant" display more osteitis fibrosa than the typical growths occurring in the epiphysis where the cortical resistance is low; less osteitis fibrosa than cysts of the diaphysis where the cortical resistance is high, and therefore occupy a position midway between the two. The prevalence of the spindle cell type in the small bones, with its greater tendency toward healing, is a fortunate circumstance which does much to explain the behavior of the vertebral lesions.

DIAGNOSIS

Giant cell tumor of the spine occurs so rarely it is likely to be omitted from the list of possibilities when a destructive vertebral lesion is under consideration. While it has been found in early childhood and in old age, it is primarily a disease of young adult life. It occurs in the male somewhat more frequently because he is more often the victim of injury, and it occurs in the cervical and upper lumbar spines more frequently because they are the more common sites of trauma. When a young adult gives a history of trauma to the spine followed by pain, tumor and possibly kyphosis, giant cell tumor should be placed upon the list of probabilities.

The roentgen-ray appearance of the lesion in the spine is not and cannot be the same as the typical, trabeculated, cortex expanding tumor of the long bones; nor does it present the same features as the lysis tumor of the long bones described by Kirklin and Moore.[11] It is primarily the picture of destruction and may occur in the spinous or transverse processes, but is more common in the lateral body at the base of the neural arch. In some instances fragments of disrupted cortex may be seen. A roentgenogram of sufficient excellence may show linear markings within the mass of the tumor but no definite new bone is seen unless healing has begun. In several cases collapse of the vertebral body has been noted. The roentgenographic appearance is not characteristic but does give the general impression of being benign. When healing begins, either spontaneously or following partial removal, there develops throughout the involved area an irregular calcification which confirms the impression of non-malignancy.

The tumor found at the site of the lesion is usually small and firm, but is sometimes quite soft. Kyphosis is present if collapse of the vertebral body has occurred. Pain, tenderness, limitation of motion and localized muscle spasm are constant symptoms. Motor and sensory disturbances below the level of the lesion are dependent upon the degree of impingement on the spinal cord. Loss of weight is common and Bower, Clark and Davis[4] give cachexia as a consistent finding.

The usual complaints are severe pain in the back, muscular weakness and numbness in the lower extremities and disturbances of the rectal and vesical sphincters. Incontinence of urine is apt to persist after all other symptoms have disappeared.

The usual history is that of injury to the spine followed by pain, which may persist or may reappear after a period of comfort. The patient discovers the tumor from one to six months following injury but often does not seek medical aid until driven to do so by increase in pain, the appearance of cord symptoms and the rather rapid growth of the tumor mass. Therefore these cases are often not examined until twelve or eighteen months after the onset of the disease. In one or two cases a second injury several months after the first resulted in pathological fracture, collapse of the vertebral body, kyphosis and the sudden appearance of syptoms due to cord involvement.

The diagnosis of giant cell tumor of the spine should be made, if possible, without recourse to biopsy. Since it presents no pathognomonic signs, only elimination of similar lesions can give reasonable certainty to its identification. It must be differentiated from (1) tuberculosis, which is recognized by its origin in the vertebral disc with obliteration of the intervertebral space, destruction usually confined to the anterior vertebral bodies above and below, systemic manifestations, and tuberculous foci elsewhere; (2) syphilis (Charcot spine), which is characterized by destruction of the entire superior vertebral body, the remaining portion being left as a pencil of uninvolved bone, the presence of bone débris, evidence of the disease elsewhere, a positive complement fixation reaction, a suggestive history and a response to antisyphilitic treatment; (3) non-pathological fracture, which is recognized by the absence of tumor and bone destruction, the

characteristic fracture deformity with displacement of fragments and by the history; (4) spondylitis traumatica tarda (Kümmell's disease), which may have a history quite similar to that of giant cell tumor but, whether it be an entity or simply an unrecognized fracture as claimed by O'Brien,[14] shows no destruction, no tumor and no involvement beyond the vertebral body; (5) Hodgkin's disease and lymphosarcoma, which almost invariably show evidence of the disease elsewhere, have more or less sclerosis accompanying the destruction of the spine and should receive the same treatment as giant cell tumor in any event; (6) osteitis fibrosa cystica which, when it occurs as a solitary lesion in the spine, is probably in reality a giant cell tumor and demands the same treatment, but is more often a manifestation of generalized fibrocystic disease and is recognized by the presence of lesions in other bones and by a disturbance of the blood calcium and phosphorus (hyperparathyroidism). It is interesting to note that Adson[1] reported 2 cases of giant cell tumor of the spine under the title "osteitis fibrosa cystica"; (7) metastatic malignancy, which is most commonly secondary to carcinoma of the breast, carcinoma of the prostate, osteogenic sarcoma, and hypernephroma. The primary lesion is usually known or can be discovered. Metastases in the spine are usually multiple and can also be found in other bones, the carcinomatous ones having a tendency to sclerosis, especially those from the prostate. In any case the treatment is the same as that of giant cell tumor; (8) primary neoplasms of the vertebrae are so rare as to be unimportant, although chondroma and chondrosarcoma are said to occur as solitary lesions.[9] Myeloma occurs but is multiple in the spine even if not found in other bones.

## TREATMENT

Because of its anatomical location the question of resection and amputation obviously does not arise in a discussion of the treatment of giant cell tumor of the vertebra. There remains a choice between partial surgical removal and irradiation.

Geschickter and Copeland[8] do not favor either roentgen irradiation or radium implantation but advise as complete curettement as possible with careful thermal and chemical cauterization. Bloodgood concurs in this opinion. Adson[1] advises the removal of as much of the tumor as possible, curettement and filling the cavity with bone fragments. In 1924 Lewis[12] treated his case by partial surgical removal and felt this procedure to be preferred, but commented upon the apparent good results of Coley's toxins and irradiation. He also noted the greater tendency of the spine lesions toward spontaneous ossification as compared with those in the long bones. In 1924 Coley[5] thought curettement to be preferred. In 1930 Santos[18] thought operation the best procedure. He likewise commented on the special tendency of spinal lesions to heal by ossification, spontaneously or following partial removal.

In contrast to these opinions, Cotton,[6] in 1928, advised roentgen irradiation if a diagnosis could be made without section, or if necessary an exploratory operation followed by irradiation. In 1930 Bower, Clark and Davis[4] carefully analyzed the treatment used in 29 cases and concluded that giant cell tumors of the spine were not so benign as those occurring elsewhere; that exploration, curettage, and partial or complete removal stimulated to further activity and were unjustified; and that the best treatment was the insertion of radium into the growth by the closed method. Their own case was successfully treated with radium. In 1930 Meyerding[13] expressed his preference for the roentgen ray and reported a case successfully treated. He also advised against biopsy or curettement, as time clears up any doubt as to diagnosis, and operation on a malignant lesion of the spine is of little value. In 1932 Pfahler and Parry[16] reported a series of 26 cases of giant cell tumor treated by roentgen irradiation, the first in 1906, the earliest on record. None of their

cases were of the spine but all showed a satisfactory response. They expressed the opinion that curettement and crushing of the bone are a definite disadvantage. In 1932 Peirce[15] reported a series, which included 2 spine cases, and expressed the opinion that irradiation was the treatment of choice. Pirie, Herendeen and Ewing, in discussing the work of Pfahler and Parry[16] and Peirce,[15] strongly advised irradiation and against the surgical treatment of giant cell tumor.

The disposition to depend upon irradiation rather than surgery in the treatment of these growths is well founded, more particularly when they arise from the vertebrae. Cotton[7] feels that the relief of pressure within the growth, whether from surgery or fracture, is the factor which initiates the healing reaction. There is a basis for his opinion since there is a definite tendency toward regression following fracture and since surgical removal at best must be incomplete. If these tumors are reasonably sensitive to irradiation, and they have proved to be so, moderate doses of roentgen radiation should check multiplication of giant cells and lower the intratumor pressure. If, at the same time, the fibroblasts and the blood supply are not damaged, a condition is produced which allows the defensive elements to gain ascendancy with an increase in the fibrous reaction and ultimate healing by calcification.

The usual tendency of giant cell tumors of the spine to recur following curettement has been stressed by Bower, Clark and Davis,[4] and mentioned by other observers. Geschickter and Copeland[9] point out that there is no microscopic difference between the recurrent and non-recurrent tumors. They maintain that recurrence is seen most frequently after the age of thirty, when the cortical bone has declined in its power to heal and ossify, and consistently follows extensive operative destruction of the limiting shell of cortical bone, coupled with incomplete removal. Since cortical bone is extensively destroyed in the development of lesions of the vertebrae and since curettement in this location must of necessity be incomplete and usually destructive of any limiting capsule, it is reasonable to believe that the tendency to recurrence in the spine is a peculiarity of location and not a factor of malignant tendency as held by Bower, Clark and Davis.[4]

In considering the question of malignancy and metatasizing of giant cell tumor, Geschickter and Copeland[8] say that "malignant modification in the microscopic structure of a giant cell tumor is usually the result and not the cause of recurrence." They also state that when a "malignant variant" is present in the primary growth and recurrence results, metastasis is apt to follow, but in such cases the correct diagnosis is sarcoma and not giant cell tumor. They have not found a metastatic giant cell tumor nodule in the lung nor have they found a proved case of coexisting benign giant cell tumor of the bone and osteogenic sarcomatous metastasis in the lung. These facts seem to warrant the statements that "giant cell tumors of the vertebrae have a greater tendency toward spontaneous healing than those of the long bones. They are disposed to recur if disturbed surgically, and if, in rare instances, the lesion is really osteogenic sarcoma, surgery is contraindicated. Therefore, the treatment of choice is irradiation applied externally."

It has already been intimated that a regimen of irradition should have as its aim an inhibitory action upon the osteoclastic giant cells without unnecessary damage to the defense elements. Pfahler and Parry,[16] who have had wide experience in the roentgen treatment of giant cell tumors, recommend the following technique: 200 kv., 0.5 mm. copper filtration, distance of 50 cm., doses of 25 per cent skin erythema given successively through one, two, three or four ports of entry. If the case is clearly giant cell tumor, treatments need not be given more than three times a week, but if there is doubt as to the diagnosis, treatments should be given daily until the tumor is brought to 100 per cent erythema

dose (Pfahler's saturation technique). After the treatment period of three weeks, an interval of six weeks should elapse and the case be restudied. The response should indicate the correctness of the diagnosis and be a guide to further treatment.

It cannot be overemphasized that every patient with a questionable bone lesion should have a complete clinical study, including a determination of the blood calcium and phosphorus, a blood Wassermann test and a roentgen examination of the entire skeleton. If roentgen therapy is administered while the clinical data are being collected, no harm will result and the response to irradiation will frequently be a valuable diagnostic aid.

## CASE REPORT

On May 31, 1931, a white female, aged twenty, was admitted to the Aston Park Hospital. Her illness began in the late summer of 1929 when she received an injury to the mid-back in an automobile accident. Her pain was continuous from that time until her admission. Three months after injury pressure against the back of the chair in which she sat while working called her attention to a swelling in the lumbodorsal region. The swelling slowly increased but there was no kyphosis. For several months before admission there was a progressive muscular weakness in the lower extremities and a "tingling" sensation in the feet and legs but no paralysis and no disturbance of the rectal or vesical sphincters. There was some loss of weight but her general health remained good. On the day of admission she was in a second automobile accident and came to the hospital complaining of an injury to the head and severe pain in the back. Her family and past history were without interest.

*Physical Examination.* There was an extensive laceration of the scalp in the occipital region and many bruises and abrasions of the trunk and extremities. Above the mid left clavicle was a hard mass the size of a walnut. There was a moderate kyphosis in the lumbodorsal region and a firm mass the size of an orange to the left of the first lumbar vertebra, which seemed adherent to the bone. The lower extremities showed a muscular weakness and the reflexes were somewhat exaggerated but there was no paralysis or atrophy. There was a mild urinary incontinence.

*Laboratory Findings.* Urine and blood examinations, including the Wassermann reaction, showed no abnormalities. The spinal fluid was not examined.

*Roentgen Examination.* There was demonstrated a collapse of the anterior body of the first lumbar vertebra with a moderate kyphosis (Figs. 1 and 2). The center of the body, the superior half of the left lamina, and the superior half of the left transverse process showed extensive destruction. Small fragments of disrupted cortical bone were seen at the right of the vertebral body and about the partly destroyed left transverse process. No new bone was seen. A tumor mass could be faintly outlined but there were no demonstrable trabeculae. There was a cervical rib on the left, arising from the seventh cervical vertebra, with its distal extremity turned upward and outward, and corresponding in location to the bony mass felt above the clavicle. The other bones showed no pathology.

After a consideration of the possibilities, giant cell tumor arising from the left body of the first lumbar vertebra seemed the most logical diagnosis. Surgical intervention, even for biopsy, was considered unwise. High voltage roentgen therapy was advised but was deferred because of the patient's personal circumstances. A plaster-of-Paris body cast was applied, with the spine hyperextended, and the patient left the hospital after a few days.

On August 12, 1931, ten weeks after her first admission, she returned to the hospital. Roentgen examination showed no additional destruction and definite calcification of the mass had begun. The kyphosis had been largely corrected. Since it was necessary for her to return home it was decided not to insist on roentgen therapy. Subsequent roentgen examinations were made on October 30, 1931, December 24, 1931, and July 10, 1932, which showed a progressive calcification. In July the cast was discarded and the patient was allowed up with a special corset which she continues to wear. During her stay in bed she suffered a great deal from constipation, gastrointestinal distress and urinary incontinence. She developed a decubitus ulcer from poor nursing in the home.

On January 9, 1933, she presented herself for a final examination, having done a moderate amount of walking for the past three

months. There was only a slight gibbus. The tumor to the left of the spine had decreased in size and was very hard. There was marked limitation of motion and some spasm of the lumbar muscles. The muscular weakness had largely disappeared. The reflexes in the lower extremities were somewhat exaggerated. There were no disturbances of sensation. The patient complained of some pain in the back and tired quickly but was leading a fairly normal life. Her gastrointestinal discomfort had disappeared but the constipation and some urinary

FIG. 1. Destruction of body and left transverse process of first lumbar vertebra. Expanded cortex of transverse process. Roentgenogram made May 31, 1931.

FIG. 2. Collapse of body of first lumbar vertebra. Destruction of left lamina. Roentgenogram made May 31, 1931.

incontinence persisted. The roentgen examination showed no new destruction. There was very little kyphosis. The destroyed areas were almost completely recalcified (Figs. 3 and 4) and there was limited dense calcification at the site of the tumor. Examination of the long bones showed no pathology.

*Comment.* This is considered a typical case of giant cell tumor of the vertebra. There was a history of trauma, pain and tumor in a young adult. A second injury caused pathological fracture and collapse

Fig. 3. Recalcification of destroyed areas of body and transverse process. Roentgenogram made January 9, 1933.

Fig. 4. Kyphosis largely corrected. Recalcification of lamina and calcareous deposits within the tumor mass. Roentgenogram made January 9, 1933.

of the vertebral body. Without other treatment than hyperextension and immobilization the healing process began and was observed to its final stage. Curettement was considered unwise and biopsy for diagnosis was not justified. Roentgen therapy was advised but refused and the opportunity was given to observe spontaneous healing. There was the customary persistence of the disturbance of the vesical sphincter. The unusual features of the case were a second injury producing pathological fracture; the progress of the tumor until fracture occurred with the demonstration of beginning calcification immediately following collapse; the complete spontaneous healing; the little cord involvement with such extensive destruction; the complete absence of recurrence or evidence of malignancy more than three years after onset; the confusing presence of a tumor above the left clavicle which was proved by the roentgen ray to be a cervical rib.

## SUMMARY AND CONCLUSIONS

1. Forty-five cases of giant cell tumor of the spine have been found in the literature.

2. Giant cell tumor of the vertebra is a rare, bone destructive, lesion occurring more frequently in the young adult.

3. A sequence of injury, pain, tumor and symptoms of cord pressure cause the patient to seek medical aid.

4. Giant cell tumor is an abnormal variation of the process of repair. It is not a true neoplasm and is never malignant.

5. A diagnosis should be made without biopsy. Even if a mistake be made in diagnosis nothing is lost since operation on a malignancy of the vertebra is definitely contraindicated.

6. Since giant cell tumors of the vertebrae display a special tendency toward healing and since curettement is prone to damage the defense mechanism and be followed by recurrence, the treatment of choice is external irradiation rather than surgery.

7. Irradiation should be given in moderate doses and have as its aim the inhibition of giant cell growth without undue damage to the tissues engaged in repair.

8. A case is presented which illustrates many points brought out in this paper.

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# PELVIC KIDNEY WITH URETER OPENING NEAR URETHRAL ORIFICE

## REPORT OF CASE

*By* E. M. VAN BUSKIRK, M.D.
FORT WAYNE, INDIANA

R. T., female, single, aged nineteen, was sent for roentgen study to determine the cause of urinary incontinence from childhood. She had had the usual childhood diseases, and was apparently healthy. She suffered from a constant leakage of urine, which for the past six months had become foul smelling and purulent. This caused her to shun her companions, and was very embarrassing at work. She voided clear, normal urine at proper intervals. An ectopic ureter was suspected, but the orifice was not found on former repeated examinations.

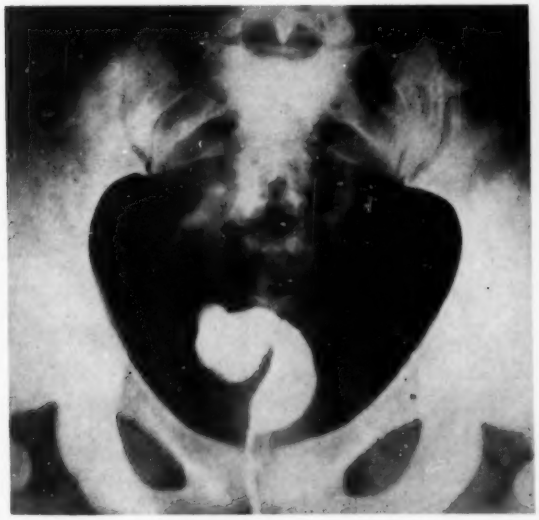
*Examination.* I made roentgenograms before and after giving intravenous dye. These films showed the left kidney normal in size and position with pelvis fairly well filled. On the right side there was an absence of dye, and no renal shadow was suggested.

The patient was referred to Dr. A. J. Sparks, who, after several lengthy searches, was unable to locate this suspected ectopic opening. No right ureteral orifice was found by cystoscopic examination. With the above history he felt that she had a pyonephritic kidney with an external ureteral orifice and advised nephrectomy.

December 11, 1931, she was operated upon. The usual loin incision was made and no right kidney could be found. The incision was closed and nothing further was attempted. Later under general anesthesia the urethra was dilated, and after a diligent search, the ureteral orifice was found just within the external urethra on the right posterior surface. A catheter was passed a distance of 5 cm. and a contrast medium was injected.

Roentgenograms were made in the anteroposterior (Fig. 1) and oblique position (Fig. 2). These show a very much dilated ureter about 10 cm. in length, with a sacculation at its lower end. The fluid did not ascend to a definite kidney pelvis. However, a pelvic kidney was suspected.

A second operation was performed by Dr. Sparks on November 12, 1932, and the usual pelvic incision was made. A rudimentary kidney was found to the right of the sacrum. This was removed but, owing to dense adhesions and great depth, the removal of the ureter was



FIGS. 1 and 2. Anteroposterior and right oblique roentgenograms, illustrating a very much dilated ureter with a sacculation near outlet.

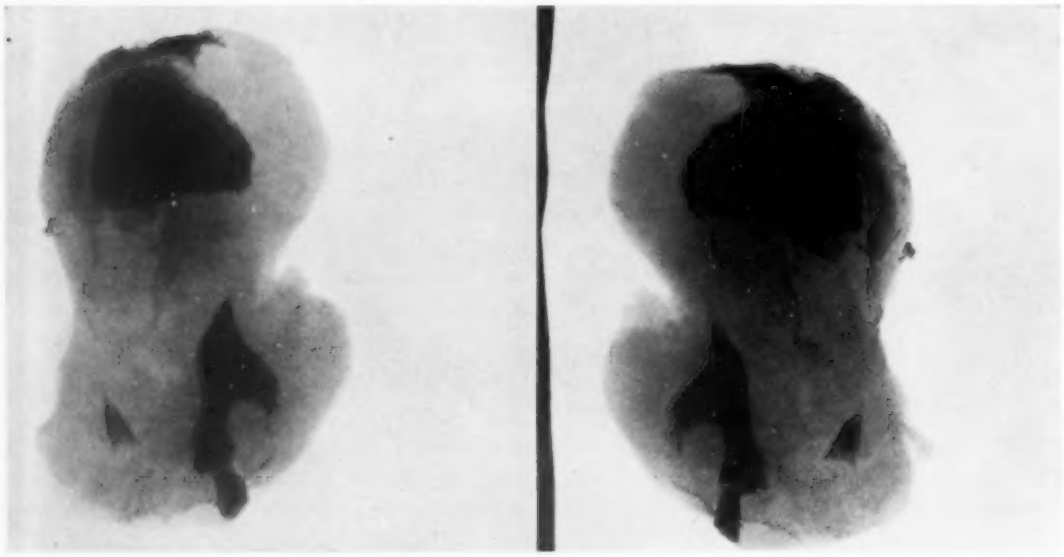


FIG. 3. Roentgenogram of undeveloped right kidney after operative removal.

not attempted. This kidney was 7 cm. in length and undeveloped. After injection a roentgenogram was made of the excised kidney (Fig. 3).

*Comment.* The right renal system is anomalous. The kidney is of the pelvic type and undeveloped, connected with an ectopic ureter emptying near the external urethral orifice. This is a true congenital condition which seems to be very rare.

*Embryology.* Very early in fetal life the ureter is connected with the lower portion of the Wolffian duct. It later separates from the duct and becomes connected with the allantois which in the future develops into the bladder.[1] Should the ureter and the duct fail to separate and make their descent together, there might be an abnormal outlet of the ureter in the seminal vesicle system in the male, or into Gartner's duct or structures later developed from it in the female. Should the fusion of the ureter and the Wolffian duct continue past the sixth week of fetal life, the opening might be associated with the upper portion of the urethra or prostate in the male, or the urethra or vagina in the female, structures developing from the urogenital sinus.[2] This is probably what happened in this case.

## SUMMARY

This anomaly is quite different in many respects from any I have been able to find in medical literature, and I am making this report to increase the number of listed congenital defects.

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Vol. 34, No. 3

# THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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*Publisher:* Charles C Thomas, 220 East Monroe St., Springfield, Illinois.

*Issued Monthly. Subscription $10.00 per year, $11.00 in Canada and $12.00 in foreign countries. Advertising rates submitted on application: Editorial office, 110 Professional Building, Detroit, Mich. Office of publication 220 E. Monroe St., Springfield, Ill. Information of interest to all readers will be found on page iv.*

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# EDITORIAL

## THE ADOLESCENT SACROILIAC JOINT SYNDROME

ROENTGENOLOGISTS are quite familiar with that rather large group of diseases known as Legg-Calvé-Perthes' disease, Köhler's disease, Osgood-Schlatter's disease and the various other forms of epiphysitis or apophysitis which attack the epiphyses of growing children and adolescents, but there is a disease of adolescence involving the sacroiliac joints which until recently has gone unrecognized.

A recent report by Rogers and Cleaves[1] calls attention to a definite clinical syndrome which manifests itself in adolescence and is limited to one sacroiliac joint. The symptomatology manifests itself in stiffness of the low back, and pain and tenderness over the sacroiliac joint, often with sciatic pain and peculiar gait due to the loss of straight leg raising. These symptoms are apt to appear in a rather stocky boy or girl who is a little overweight and shows some of the characteristics of the Fröhlich type, though frequently the process is seen in the vigorous adolescent who engages in rather strenuous athletic sports, and in this respect it is not unlike Scheuermann's disease.

The physical findings, Rogers and Cleaves state, are apt to be quite definite. In the severe types there may be a protective list away from the side of the symptoms; on standing, the motions are restricted—forward bending is limited, while lateral bending is more restricted on one side than on the other—and there is often localized tenderness over the posterior ligaments of the sacroiliac joint. The symptoms usually center about one sacroiliac joint. Attention is called to the fact that some slight strain during play not sufficient at first to create a definite impression is the common source, but once the symptoms start, repeated injuries apparently aggravate the pain and stiffness.

In searching for a possible cause of these clinical symptoms, Rogers and Cleaves began a study of the epiphyseal growth area in the sacroiliac joint region and much to their surprise they found a very limited literature on the subject. However, in Cunningham's Anatomy "there appears a description of the development of the sacrum, in which mention is made of the lateral epiphyses of the sacrum. These are small epiphyses which develop along the lateral margins of the sacrum." The increased width of the sacroiliac joints in children as compared with those in adults is well known and this width tends to decrease as adult life is reached until there is complete fusion of the epiphyses of the pelvic bones.

The part that these lateral epiphyses play in the development of the sacroiliac joints was studied roentgenographically. In order to do this Rogers and Cleaves took stereoscopic plates of the epiphyses of normal joints at six month intervals and they came to the conclusion that these epiphyses appear during the fifteenth or sixteenth year, though they did see them in one patient of thirteen years. They also noticed that in some of the epiphyses one or both sacroiliac joints might show a cloudy appearance with some irregular areas of increased density at the site of the lateral epiphyses, and in this group of cases they observed that the sacroiliac joints were quite slow in assuming adult appearance or they were very irregular, even suggesting pathological changes, yet

[1] Rogers, M. H., and Cleaves, E. N. The adolescent sacroiliac joint syndrome. *J. Bone & Joint Surg.*, July, 1935, *17*, 759–768.

the patients complained of no back symptoms.

The cases which presented the clinical picture of sacroiliac disturbance have shown rather bizarre changes in the sacroiliac joints; at times there was a picture simulating an infectious arthritis, tuberculosis, or osteomyelitis, with the joint spacings quite hazy and irregular, sometimes assuming a moth-eaten appearance. They also observed that usually there were some changes in both sacroiliac joints but the joint on the side which was presenting symptoms showed the greater changes and not infrequently the symphysis pubis was somewhat out of alignment, suggesting abnormal mobility in one or both sacroiliac joints. The changes seen resembled strikingly those observed in other epiphyseal disturbances or apophysitis.

Rogers and Cleaves report ten cases manifesting these changes to a greater or lesser degree, and for this particular clinical picture they suggest the term "the adolescent sacroiliac joint syndrome." Apparently the clinical picture and the roentgen findings are at times confusing as many of the cases which they observed had been previously diagnosed as osteomyelitis or tuberculosis or acute infectious arthritis of the sacroiliac joint. The syndrome occurs with sufficient frequency to warrant a familiarity with both its clinical and roentgenological manifestations and since so little roentgenological study has apparently been made on the sacroiliac joints in adolescence, particularly with reference to the epiphyses, an opportunity is offered as a result of the work of Rogers and Cleaves for a more intensive study of this area.

# SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

*Items for this section solicited promptly after the events to which they refer.*

## MEETINGS OF ROENTGEN SOCIETIES*

### UNITED STATES OF AMERICA

AMERICAN ROENTGEN RAY SOCIETY
*Secretary*, Dr. E. P. Pendergrass, University Hospital, Philadelphia, Pa. Annual Meeting: Atlantic City, N. J., Sept. 24–27, 1935.

AMERICAN COLLEGE OF RADIOLOGY
*Secretary*, Dr. B. H. Orndoff, 2561 N. Clark Street, Chicago, Ill. Annual meeting: Kansas City, Mo., 1936.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
*Secretary*, Dr. J. T. Murphy, 421 Michigan St., Toledo, Ohio. Annual meeting: Kansas City, Mo., 1936.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
*Secretary*, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N.Y. Annual meeting: Detroit, Mich., Dec. 2–6, 1935.

RADIOLOGICAL SECTION, BALTIMORE CITY MEDICAL SOCIETY
*Secretary*, Dr. W. B. Firor, 1100 N. Charles St., Baltimore. Meets third Tuesday each month, September to May.

RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY
*Secretary*, E. N. Liljedahl, Los Angeles, Calif. Meets on the fourth Wednesday of each month at the California Hospital.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
*Secretary*, Dr. H. J. Walton, 104 W. Madison St., Baltimore, Md. Annual meeting, St. Louis, Mo., Nov. 19–22, 1935.

BROOKLYN ROENTGEN RAY SOCIETY
*Secretary*, Dr. E. Mendelson, 120 E. 19th St., Brooklyn, N.Y. Meets monthly on first Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY
*Secretary-Treasurer*, Dr. Joseph S. Gian-Franceschi, 610 Niagara St., Buffalo, N.Y. Meets second Monday of each month except during summer months, place of meeting selected by the host.

CHICAGO ROENTGEN SOCIETY
*Secretary*, Dr. R. G. Willy, 1138 N. Leavitt. Meets second Thursday of each month October to May inclusive at the Palmer House.

CINCINNATI RADIOLOGICAL SOCIETY
*Secretary*, Dr. H. G. Reineke, General Hospital, Cincinnati, Ohio. Meets third Monday of each month, October to May, inclusive.

CLEVELAND RADIOLOGICAL SOCIETY
*Secretary*, North W. Shetter, M.D., 14600 Detroit Ave. Meetings are held at 6:30 P.M. at the Cleveland Chamber of Commerce Club rooms on the fourth Monday of each month from October to April, inclusive.

DENVER RADIOLOGICAL CLUB
*Secretary*, Dr. K. D. A. Allen, 452 Metropolitan Building, Denver, Colorado. Meets on any month having a fifth Monday.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
*Secretary*, Dr. E. R. Witwer, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne Country Medical Society Building.

FLORIDA STATE RADIOLOGICAL SOCIETY
*Secretary*, Dr. Gerard Raap, Miami, Florida. Meetings held twice a year, May and November.

ILLINOIS RADIOLOGICAL SOCIETY
*Secretary*, Dr. H. W. Grote, 219 N. Main St., Bloomington, Ill. Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
*Secretary*, Dr. J. N. Collins, Indianapolis, Ind. Meeting held the second Sunday in May annually.

LONG ISLAND RADIOLOGICAL SOCIETY
*Secretary*, Dr. M. Dannenberg, 1464 Eastern Parkway, Brooklyn, N. Y. Meets on third Thursday of each month from October to May, at 8:30 P.M.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS
*Secretary*, Dr. S. W. Donaldson, St. Joseph's Mercy Hospital, Ann Arbor, Mich. Three meetings a year, Fall, Winter, and Spring.

MILWAUKEE ROENTGEN RAY SOCIETY
*Secretary*, Dr. S. A. Morton, Columbia Hospital, Milwaukee, Wis. Meets monthly. Place of meeting designed by the president.

MINNESOTA RADIOLOGICAL SOCIETY
*Secretary*, Dr. L. G. Rigler, University Hospital, Minneapolis, Minn.

NEW ENGLAND ROENTGEN RAY SOCIETY
*Secretary*, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass. Meets monthly on third Friday, Boston Medical Library.

RADIOLOGICAL SOCIETY OF NEW JERSEY
*Secretary*, Dr. P. S. Avery, New Brunswick, N. J. Meets annually at time and place of State Medical Society. Mid-year meetings at place designated by the president.

NEW YORK ROENTGEN SOCIETY
*Secretary*, Dr. E. F. Merrill, 30 W. 59th St., New York. Meets monthly on third Monday, New York Academy of Medicine, at 8:00 P.M.

NORTH CAROLINA ROENTGEN RAY SOCIETY
*Secretary*, Dr. Major Fleming, Rocky Mount, N. C. Annual meeting at time and place of State Medical Society. Mid-year scientific meeting at place designated.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
*Secretary*, Dr. C. F. Potter, 820 S. Crouse Ave., Syracuse, N.Y. Three meetings a year—January, May, and November.

PACIFIC ROENTGEN CLUB
*Secretary*, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association

PENNSYLVANIA RADIOLOGICAL SOCIETY
*Secretary*, Dr. L. E. Wurster, Williamsport, Pa.

PHILADELPHIA ROENTGEN RAY SOCIETY
*Secretary*, Dr. Thomas Loughery, Germantown Hospital. Meeting first Thursday of each month from October to May inclusive, at 8:15 P.M., in Thompson Hall, College of Physicians, 19 S. 22d St.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N.Y.
*Secretary*, Dr. W. W. Fray, Strong Memorial Hospital. Meets monthly on second Thursday from October to May, inclusive, at 7:45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN RAY SOCIETY
*Secretary*, Dr. P. C. Schnoebelen, Missouri Bldg., St. Louis, Mo. Meets first week of each month. Time and place of meetings designated by president.

SOUTH CAROLINA X-RAY SOCIETY
*Secretary*, Dr. R. B. Taft, 105 Rutledge Ave., Charleston. Meets at time and place of South Carolina State Medical Association.

TENNESSEE RADIOLOGICAL SOCIETY
*Secretary*, Dr. F. B. Bogart, 311 Medical Arts Bldg.

* Secretaries of Societies not here listed are requested to send the necessary information to the Editor.

Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
*Secretary-Treasurer*, Dr. J. H. Smith, Lubbock, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

University of Michigan Department of Roentgenology Staff Meeting
*Secretary*, Dr C. B. Peirce, University Hospital, Ann Arbor, Mich.
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Roentgen Club
*Secretary*, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis.
Meets monthly on last Thursday, October to April, Service Memorial Institute, at 4:30 P.M.

Virginia Roentgen Ray Club
*Secretary*, Dr. V. W. Archer, University Hospital, University, Va.
Meets annually in October.

### Cuba

Sociedad Cubana de Radiologia y Fisioterapia
*Secretary*, Dr. Francisco Padron, Enrique, Villuendas 64, Havana, Cuba. Meets monthly in Havana.

### British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St., London, W. 1, or as advertised.

Electro-Therapeutic Section of the Royal Society of Medicine (Confined to Medical Members)
Meets on the third Friday of each month during the winter at 8:30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

Section of Radiology and Medical Electricity, Australasian Medical Congress
*Secretary*, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Radiological Section of the Victorian Branch of the British Medical Association
*Secretary*, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

Section on Radiology, Canadian Medical Association
*Secretary*, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

Radiological Section, New Zealand British Medical Association
*Secretary*, Dr. P. C. Fenwick, The Hospital, Christchurch. Meets annually.

### Continental Europe

Belgian Society of Roentgenology
*Secretary*, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

Société de Radiologie Médicale de France
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

Société Suisse de Radiologie (Schweizerische Röntgen-Gesellschaft)
Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse, Biel.
Meets annually in different cities.

Société Francaise d'Electrothérapie et de Radiologie Médicale.
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

Association of German Roentgenologists and Radiologists in Czecho-Slovakia
*Secretary*, Dr. Walter Altschul, German University, Prague, II.52.

Deutsche Röntgen-Gesellschaft (Gesellschaft für Röntgenkunde und Strahlenforschung)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
*Permanent secretary*, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

Süd- und Westdeutsche Röntgengesellschaft
Meets annually in different cities.

Nord- und Ostdeutsche Röntgengesellschaft
Meets annually in different cities.

Dutch Society of Electrology and Roentgenology
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

Societa Italiana Radiologia Medica
*Secretary*, Professor M. Ponzio, University of Turin, Turin.

Societatea Romana de Radiologie si Electrologie
*Secretary*, Dr. Virgil Ionescu, B-dul Schitu Măgureanu 49, Bucarest.
Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
*Secretaries*, Drs. S. A. Reinberg and S. G. Simonson.
Meets annually.

Leningrad Roentgen Ray Society
*Secretaries*, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly, first Monday at 8 o'clock State Institute of Roentgenology and Radiology, Leningrad.

Moscow Roentgen Ray Society
*Secretaries*, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

Polish Society of Radiology
*Secretary*, Dr. Jan. Kochanowski, 45 Gornoslazka St., Warsaw. Meets annually.

Warsaw Section, Polish Society of Radiology
*Secretary*, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with exception of the Denmark Society, meets every second month except in the summertime.

Society of Medical Radiology in Sweden
Meets in Stockholm.

Society of Medical Radiology in Norway
Meets in Oslo.

Society of Medical Radiology in Denmark
*Secretary*, Dr. G. Biering, Copenhagen.
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

Society of Medical Radiology in Finland
Meets in Helsingfors.

Vienna Roentgen Society
Meets first Wednesday of each month, at 6.30 P.M. at Zentral-Röntgen Institut des allgemeinen Krankenhauses Alserstrasse 4.

### Orient

Japan X-Ray Association
c/o Orthopedic Surgery, Tokyo Imperial University.
Meets annually in April.

Kinki Roentgen-Abend Society
Director, Dr. Prof. Taiga Saito, Ogawaoike Tyoto, Japan. Meets bi-monthly on third Sunday.

## AUSTRALIAN AND NEW ZEALAND ASSOCIATION OF RADIOLOGY

On February 6, 1935, there was organized the "Australian and New Zealand Association of Radiology," with the first annual meeting held at Canberra on May 17. The following officers were elected: President: Dr. A. T. Nisbet, New South Wales; Vice-President: Dr. H. M. Hewlett, Victoria; Treasurer: Dr. H. R. Sear, New South Wales; Secretary: Dr. H. M. Cutler, New South Wales. Branches of this Association are established in all the states and New Zealand with a Federal Council controlling affairs in general.

With regard to the publication of a separate journal, the Association is not considering that for the present. The editors of the *Medical Journal of Australia* and the *New Zealand Medical Journal* have offered to add the extra number of pages that may be required for articles written by members of the Association. These pages are to be paid for by the Association and are to be included as a supplement to the above journals. An editorial committee will review papers received and decide on those that are to be published.

## DR. FEASTER HONORED

Dr. O. O. Feaster, radiologist at St. Anthony's Hospital, St. Petersburg, Florida, was elected President-elect of the Florida State Medical Association at the meeting held at Ocala in May.

Vol. 34, No. 3

# DEPARTMENT OF TECHNIQUE

*Department Editor:* Robert B. Taft, M.D., M. S., 105 Rutledge Ave., Charleston, S. C.

## A SIMPLE METHOD OF ROENTGEN PELVIMETRY*

*By* D. B. HARDING, M.D.
LEXINGTON, KENTUCKY

THE following method of making obstetrical measurements of the female pelvis offers a technique which is simple, rapid, and accurate. It is a modification of the method described by Thoms,[1] and has as its chief advantage the elimination of all mathematical calculation.

The usual roentgenogram of the pelvis is made with the plane of the inlet parallel to the plane of the film, as described by Jarcho.[2] A note is made of the distance between the top of the roentgenographic table and the plane of the inlet, using as landmarks the superior border of the symphysis pubis and the interspace between the spines of the fourth and fifth lumbar vertebrae. A metal rule (Fig. 1), made up with notches along one edge at centimeter and half centimeter marks, is placed on the table at this same distance from the table top. A roentgenogram is made of the metal strip, with the tube and the film in the same relative positions as were used in making the pelvic roentgenogram. This film (Fig. 2) will be a transparent rule, marked in centimeters and half centimeters, with exactly the same linear magnification as the magnification of the pelvic inlet. It can be applied over the pelvic roentgenogram in any diameter, and the correct measurement read directly in a few seconds.

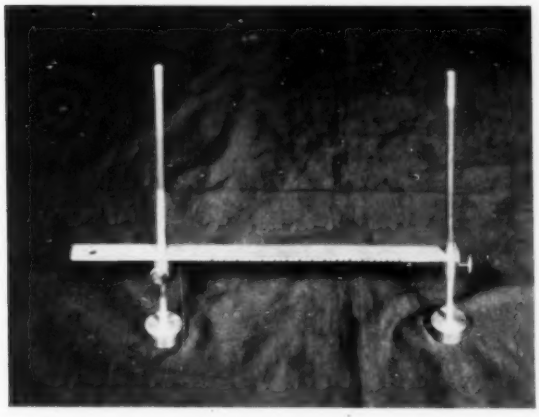

Fig. 1. Notched metal rule with adjustable supporting standards.

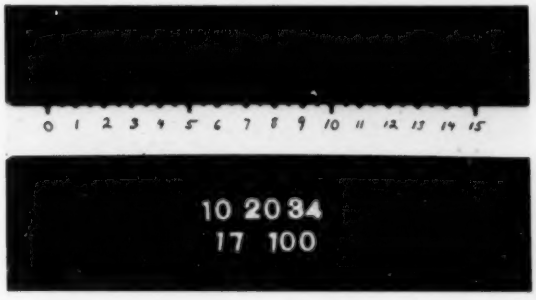


Fig. 2. Roentgenogram which is used as a transparent rule, in measuring the pelvic diameters. The numbers are written in the clear part of the film.

A complete set of these "film-rules" can be made up to fit patients of various thickness; or a separate "film-rule" can be made for each patient and filed with the roentgenogram of the pelvis.

[1] Thoms, Herbert. A new method of roentgen pelvimetry. *J. Am. M. Ass.*, 1929, *92*, 1515.

[2] Jarcho, Julius. Roentgenographic measurement of pelvic and cephalic diameters. *Am. J. Surg.*, 1931, *14*, 419–427.

* From the Lexington Clinic.

# LATERAL ROENTGENOGRAPHY OF THE HIP*

*By* MORRIS MANFREDI, *and* PAUL C. SWENSON, M.D.
NEW YORK CITY

THE value of the lateral roentgenography of the hip has only recently been emphasized in the literature, although it is by no means an innovation. Hickey[1] in 1916 described a method of lateral roentgenography of the hip. The procedure involved considerable manipulation of the extremity which obviously precludes its application in cases of fracture of the femoral neck. In the author's own words, "The technique cannot be employed in cases where the pain and disability prevent the flexion of the femur," and thus is of "value in certain select cases" only. Recently, Johnson[2] reported a new method of examination of the upper end of the femur in which a very satisfactory lateral projection is obtained. His method does not require manipulation of the extremity to be examined. Leonard and George[3] have devised a method in which they employ a special cassette with a convex curve of their own design. Kunz[4] described a method designed to obtain the same result as the others. The essential difference in the more recent method lies in the projection of the central ray and the position of the film or cassette in respect to the plane of the femoral neck. Without the aid of the curved cassette as described by Leonard and George, it is quite obvious that the best results would be obtained by projecting the central ray from below upward.

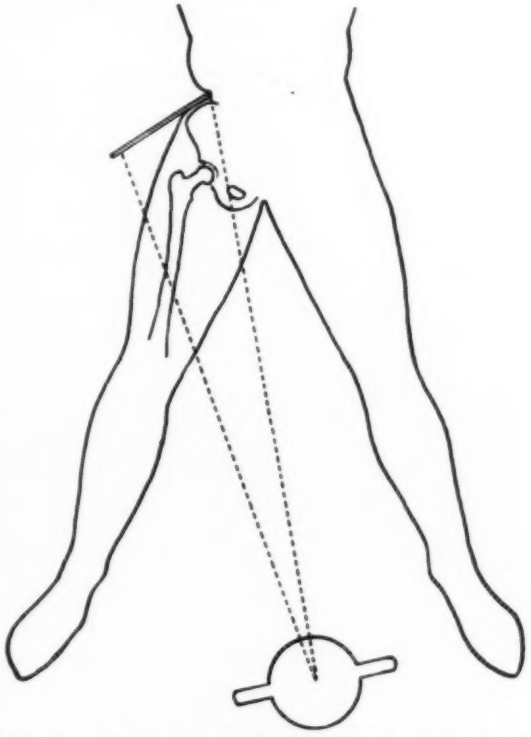

FIG. 1. A diagram showing how the central ray is projected in order to obtain the type of roentgenograms described.

FIG. 2. *a*. Anteroposterior roentgenogram of hip in a case of fracture of the neck, showing marked external rotation of the shaft, with a so-called "end to side" position of the fragments. *b*. A film taken by the technique described herein. *c*. A dried specimen with the position reproduced.

* From the Department of Roentgenology of the Presbyterian Hospital.

Up until the last year or two it has been the practice of the fracture service at Presbyterian Hospital to use only the anteroposterior stereoscopic projection in cases of fracture of the femoral neck. In the majority of instances, perhaps sufficient knowledge can be gained from these films alone, particularly when viewed by someone competent in stereoscopic appreciation; however, in some cases we have been rather surprised to find the combined opinion of several observers proved wrong at operation or when checked by a lateral film. It has therefore become our routine whenever possible to make a lateral projection.

The method we use was devised independently by one of us (M.M.), on the suggestion of Dr. William Darrach, director of the fracture service. It is approximately the same as described by Kunz with the possible exception that the roentgen tube is placed at greater distance toward the foot of the patient, which allows for less interference by the sound limb. It requires no special apparatus except that we have taken advantage of the better definition afforded by the use of the Lysholm grid. The grid and the cassette are crowded into the patient's side, above the crest of the ilium as much as possible, so as to bring the plane of the film into as nearly parallel a plane as possible with the femoral neck. This is further facilitated by the fact that the extremity at the time of examination is usually in abduction either in a cast or Thomas splint. The accompanying diagram (Fig. 1) will serve to illustrate the position of the tube and film.

The accompanying reproductions will illustrate cases showing various degrees of angulation of the neck fragment in reference to the head. It is interesting to note how difficult is the appreciation of the position of the proximal neck in the anteroposterior view, whereas the lateral projection easily shows its position. The more nearly the fracture fragments approach an "end to side" position, the more difficult it seems to interpret the findings in the anteroposterior projection. It is the lateral projection which in these cases really gives the view of the trochanter and proximal neck usually seen in the anteroposterior position. We might also call attention to the varying contour of the head fragment in its various positions of rotatory displacement.

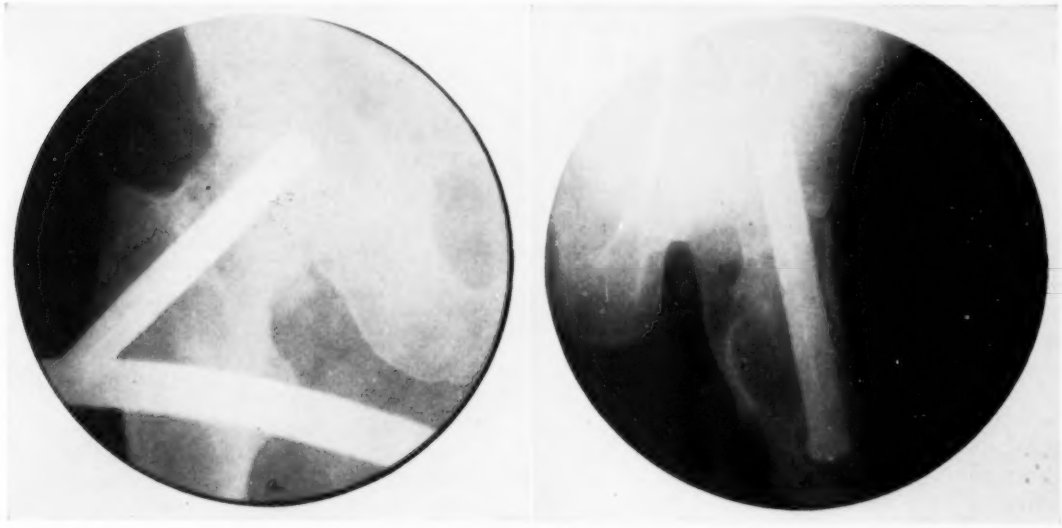

Fig. 3. *a*. Anteroposterior roentgenogram, showing position of Smith-Peterson pin. *b*. Lateral film of the femoral neck, showing the position of a Smith-Peterson pin.

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# ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

## ROENTGEN DIAGNOSIS

### HEAD

Echlin, F. Cranial osteomas and hyperostoses produced by meningeal fibroblastomas. *Arch. Surg.*, Feb., 1934, *28*, 357–405.

The author reserves the term osteoma for benign osseous productions arising from the pre-osseous tissues of membranous bones. In this article, he discusses chiefly those which occur on the external surface of the cranium. No attempt is made to distinguish these, etiologically, from osteomas of the frontal sinuses, the orbit or the inner table of the skull, but his study of 26 cases where the over-production of bone has occurred on the outer surface of the frontal, parietal or temporal bones, has prompted him to consider a particular type of osteoma. It does not include those osseous over-productions seen in syphilis or nonspecific infections, nor does it include those relatively rare over-productions which are found in cartilaginous bones—to which the author applies the term "osteochondromas."

Closely simulating these particular types of osteomas are the osteoid or osseous productions seen in meningeal fibroblastomas ("dural endotheliomas"; "meningiomas"). To this type of osteoblastic activity the author applies the term "hyperostosis." Very detailed discussion is given concerning the clinical roentgenographic, histological and theoretical considerations of these conditions. Both are comparatively insidious in their development, most of the osteomas manifesting themselves about the age of puberty, most of the hyperostoses of meningeal origin, about the fourth decade of life. In both cases, a hard, non-movable lump is characteristic; the osteomas are usually painless whereas about 50 per cent of the hyperostoses were associated with headaches or dizziness, or even failing vision and signs of intracranial pressure. Roentgenographically, the osteomas appeared as either dense or spongy overgrowths, usually comprising the outer table and extending into the diploë, occasionally effecting depression and thickening of the inner table; in the spongy variety a few radiating spicules may be seen. These are not as conspicuous as the radiations seen in meningeal hyperostoses. In later stages of the latter, radiating spicules may be seen extending from both the outer and the inner tables, but these leaving very distinctly the outline of both tables. In very early stages there might be noted, in these cases, a hypervascularization or perhaps erosions of the inner table; in the intermediate stage, radiating spicules merely from the outer table. The periosteum may be seen, at the peripheral portions of the lesion, lifted, and where the detachment is not too great, parallel rather than radiating ossification may be noted.—*A. A. de Lorimier.*

Nager, F. R. Die Bedeutung der Röntgenuntersuchung bei den Eiterungen der Felsenbeinspitze. (The importance of roentgen examinations in suppurations of the tip of the petrous bone.) *Acta radiol.*, 1934, *15*, 475–487.

The author describes 4 cases of inflammation of the apex of the petrous portion of the temporal bone diagnosed and followed up by roentgen examination. Roentgenograms and photomicrographs of the histological findings are given. In 2 of the cases the roentgen findings were verified by microscopic examination, and in 2 others by operation, which showed the site and size of the abscess cavity. The author emphasizes the importance of repeated roentgenography as a means of following up the course of the pathological process. If the symptoms are typical, even if they are few, the roentgenogram showing progressive destruction at the apex of the bone indicates the necessity for operation on the deep-seated inflammation. Cure can often be brought about in apparently desperate cases. The insertion of silver catheters into the exposed apex and subsequent roentgen examination are recommended as a good means of control of the results of operation.—*Audrey G. Morgan.*

French, Royal F. Lacrimal duct stenosis. *J. Iowa State M. Soc.*, Nov., 1934, *24*, 555–559.

The anatomy, pathology and treatment of lacrimal duct stenosis is discussed. Roentgenograms illustrative of the diagnosis by iodized oil injection of the duct are included.—*W. R. Brooksher.*

Pellini, Maria. Reperto clinico-radiologico e reperto autoptico in un caso di lesione della teca cranica di origine oscura. (Clinical, roentgen and autopsy findings in a case of skull lesion of obscure origin.) *Radiol. med.*, Sept., 1934, *21*, 1043–1053.

A case is described in a child sixteen months of age who was delivered with forceps. Soon after birth he had convulsions. When he was about seven months of age a soft tumor covered with normal scalp appeared in the occipito-parietal region. When he came to the author for examination he could not walk or remain sitting, could not speak and was retarded psychically. There were choreiform movements of the right arm and leg. His head was small and there was a large defect in the skull bones in the left parieto-temporo-occipital region. The roentgenogram was absolutely typical of cranio-hypophyseal xanthomatosis and a diagnosis of Christian-Schüller's disease was made. Roentgen treatment was ineffective, however, and the child died of bronchopneumonia.

Autopsy did not show any signs of xanthomatous infiltration at the edges of the defect in the skull or elsewhere in the body. On the basis of the anatomical findings and the history the author concluded that both the cerebromeningeal and the bone lesions were caused by trauma during labor. He thinks an intracranial hematoma formed as a result of the trauma during delivery which blocked the spinal fluid in the anterior horn of the left lateral ventricle, resulting in hypertension and erosion. This is more or less hypothetical, but the case shows that the roentgen signs of xanthomatosis may be caused by other conditions.—*Audrey G. Morgan.*

Vischia, Quintino. La sialolitiasi della ghiandola mascellare. (Salivary calculi of the maxillary glands.) *Arch. di radiol.*, 1934, *10*, 262–270.

The author describes 3 cases of sialolithiasis in patients from forty-four to fifty-four years of age. They came for examination complaining of pain in the maxillary region which began with slight pain on eating and increased until mastication became very painful. Roentgen examination showed stones in the submaxillary gland in each case which were extracted without difficulty.—*Audrey G. Morgan.*

Stein, Irvin, and Geschickter, Charles F. Tumors of the parotid gland. *Arch. Surg.*, March, 1934, *28*, 492–526.

Tumors of the parotid gland present baffling problems, clinically, pathologically, and from a therapeutic standpoint because "benign neoplasms of this organ often show malignant tendencies in that they recur frequently after simple excision, whereas the malignant tumors often show benign features in that distant metastases rarely develop." These tumors are not so rare; considering a group of 50,000 patients who had been treated surgically at the Johns Hopkins Hospital, the incidence of neoplasms of the parotid was found to be 1 to 208. Most of these cases developed between the ages of twenty and forty-five. Benign lesions accounted for 83 per cent; malignant, for only 17 per cent. Though the greatest number of either were seen about the third decade, malignant neoplasms were more common after the age of forty-five. In most of the cases, of either type, the growth was gradual; in some, there was pain (which was usually localized, in the benign cases; more likely radiating, in the malignant); either type might show adherence; more cases of the malignant than of the benign showed lymphadenopathy and ear symptoms. Most of the cases showing rapid growth proved to be malignant; in these, too, the enlargement tended to be more diffuse. Histologically, most of the benign tumors had an adenomatous arrangement with a large amount of stroma, perhaps conspicuously including myxomatous connective tissue and cartilage. Because of this pattern they are spoken of as "mixed tumors." The malignant tumors presented a lesser proportion of stroma and usually a basal cell type of epithelial elements. Less common was the cuboidal cell cancer (of Chevassu) which is thought to arise from the ductal epithelium. It is this latter type which tends to metastasize, though even in it the metastasis is usually limited, generalized or bone metastases being very rare. In consideration of differential diagnoses, the authors discuss: infectious parotitis, benign or malignant lymphadenopathy, salivary calculus, Mikulicz's syndrome, actinomycosis, tumors of the jaw and antrum and peritonsillar and buccal abscesses.

Four types of treatment had been recorded: curettage, enucleation, complete excision and irradiation by radium or roentgen rays. Of these, the first two proved entirely unsatisfactory. Complete excision by sharp dissection showed almost 86 per cent success, as far as there being no recurrence of the neoplasm but

where the lesion had attained an appreciable size, this method resulted very frequently in 7th nerve damage. Cautery excision resulted in even higher incidence of 7th nerve damage and usually considerable scarring. Radiation therapy was not frequently successful for the benign tumors but appeared to be the method of choice in the malignant cases. The authors advise preoperative irradiation in all borderline cases, though they favor ultimate excision, if the gland can be made wholly accessible.—*A. A. de Lorimier.*

MARTIN, J. D., and ELKIN, DANIEL C. Tumors of the salivary glands. *Arch. Surg.*, April, 1934, *28*, 727–741.

A brief summation is given as to the clinical and pathological aspects of 24 cases of tumors in the salivary glands. Fifty per cent of the cases occurred during the fourth decade; 25 per cent during the fifth decade. The youngest patient was twenty six; the oldest, seventy-six. The parotid was most frequently involved. In only 3 of the cases the involvement occurred in the submaxillary; no sublingual neoplasms were found. The authors divide these tumors into two types: (1) those predominantly mesoblastic and (2) those essentially epithelial. Those of the first group were usually hard, fixed to the substance of the gland but sharply outlined and movable. Histologically, they were characterized by various transitions of myxomatous tissue, fibrous tissue or even cartilage. Tumors of the second group were softer to palpation, less discretely outlined, frequently extensions from the gland proper. Microscopically, they showed a more uniform hyperchromatic type of cell, mitotic figures varying according to the rapidity of growth by the mass. Either type usually developed slowly, having the background of a small painless lump which rather suddenly increased in size. In some cases, trauma or infection was claimed. Roentgen therapy or radium irradiation followed by surgical removal is recommended. Even then the prognosis of complete elimination of the lesion is not good. Recurrent growths were found to be more malignant.—*A. A. de Lorimier.*

## NECK AND CHEST

RIGG, JAMES P. The larynx and its relation to bronchoscopy and esophagoscopy. *Nebraska M. J.*, Dec., 1934, *19*, 448–450.

In a discussion of the subject the use of the roentgen ray is advised as a routine procedure in most cases in which a foreign body is not observed by direct or indirect hypopharyngeal or laryngeal observation.—*W. R. Brooksher.*

LÜSCHER, E. Endolaryngeales Karzinom bei 37-jährigem Manne. (Intralaryngeal carcinoma in a man thirty-seven years of age.) *Acta radiol.*, 1934, *15*, 549–552.

Intralaryngeal carcinoma is comparatively rare in young individuals. The author describes a case in a man thirty-seven years of age, in which diagnosis from the clinical picture was very difficult. The age of the patient and the fact that the disease was bilateral indicated tuberculosis, but the fact that it was localized on the anterior end of the vocal cords and that there were no inflammatory changes of the rest of the laryngeal mucous membrane argued against that diagnosis, as well as the fact that the lung findings were normal. The fact that the disease was bilateral argued against cancer. An exploratory excision, however, showed cancroid of the larynx. The tumor of the left vocal cord had produced a contact ulcer on the right side. Biopsy should never be neglected in such cases and the serological reaction for syphilis should also be tested.

The patient was given roentgen treatment with a sponge rubber mold. He was given a dosage of 14,400 mg-hr. from October 28 to November 7, and a dosage of 5,760 mg-hr. from November 29 to December 3, with a distance from the skin of 3 cm., a filter of 2 mm. platinum and 60 mg. radium element. Three weeks after the beginning of the treatment the tumor disappeared. A year after the treatment the vocal cords were still slightly red but otherwise normal and the patient was completely free of symptoms.—*Audrey G. Morgan.*

HOLZMANN, MAX. Beitrag zur Kenntnis der Abweichungen des intrathorakalen Oesophagusverlaufes. (Deviations in the course of the intrathoracic part of the esophagus.) *Acta radiol.*, 1934, *15*, 443–451.

The author shows that in addition to the influence exercised on the direction of the esophagus normally by the adjoining sections of the heart and great vessels, which are sometimes demonstrable by roentgen examination, the direction of the esophagus may also be affected by the main trunk of the left bronchus. In roentgenograms taken in the oblique diameter there is sometimes a bend in the esophagus at the level of this bronchus, which divides the

esophagus into a suprabronchial and an infrabronchial part which have a different course. Under pathological conditions in the thorax that cause the main trunk of the left bronchus to be displaced backward, the bronchial bend in the esophagus may become very distinctly visible. The author also calls attention to a deviation in the course of the esophagus that may be seen in cases of disease of the aorta. It can be seen most clearly in the left anterior oblique projection in the form of a curve. It approaches and runs parallel with the descending portion of the aorta from the arch downward, the descending aorta being elongated and enlarged. In the sagittal projection under these conditions there is a bayonet-shaped bend in the esophagus at the level of the arch of the aorta, which results in a deviation to the left of the following segment.—*Audrey G. Morgan.*

Novati, Giulio Calchi. Contributo allo studio clinico-radiologico delle forme tubercolari polmonari ematogene, con particolare riguardo alle cosi dette "miliari fredde." (Clinical and roentgen study of hematogenous pulmonary tuberculosis with special reference to the so-called "cold miliary granules.") *Radiol. med.*, May, 1934, *21*, 541.

The author gives a detailed description illustrated with roentgenograms of subacute or chronic miliary tuberculosis, or as he calls it "cold miliary granules." The characteristic feature of these cases is the contrast between the mild clinical picture and the severe anatomical changes in the lung. These paradoxical findings are probably due to several causes, among them the fact that the bacteria are of low virulence and localized entirely in the lung parenchyma; probably only small numbers of them lodge in the lungs at different periods and the patient's tissues are particularly resistant.

Practically the only possible method of diagnosing these cases is by roentgen examination. The roentgenogram shows miliary nodules, some of them with fibrosis or calcification, accentuation of the lung design which is finely trabeculated and decreased transparency of the surrounding lung tissue which is uniformly veiled. There are other conditions with which they may be confused such as miliary carcinoma, pneumoconiosis, etc., but a differentiation can generally be made by a careful study of the clinical and roentgen picture.—*Audrey G. Morgan.*

Impallomeni, Rosario. L'indagine radiologica nella risoluzione della polmonite lobare. (The roentgen picture in resolution of lobar pneumonia.) *Radiol. med.*, April, 1934, *21*, 404-423.

The roentgenogram of the stage of resolution of lobar pneumonia shows a special reticulate outline which is very characteristic and is seen in all cases. The reticulum is formed by the intrapulmonary lymphatics which are thickened and engorged by the liquefied exudate which they have absorbed. The date of appearance and the course of this roentgen picture depend on whether the course of the disease is the normal and regular one rather than on the severity of the disease. This picture persists after the disappearance of clinical signs and disappears gradually in the course of a few weeks.

Resolution in lobar pneumonia should be followed up by roentgen examination so as to detect any abnormalities in its course at an early stage.

While this reticulate picture is very characteristic of resolution in lobar pneumonia, it is not pathognomonic. Similar pictures may be seen in tuberculous inflammation of the lungs and in metastatic carcinoma of the lungs of the angiolymphatic type.—*Audrey G. Morgan.*

Faravelli, Alberto. Reperti radiologici di bolle d'enfisema extrapleurico in corso di pneumotorace. (Extrapleural bullae of emphysema demonstrated in the course of pneumothorax by roentgen examination.) *Radiol. med.*, Sept., 1934, *21*, 1031–1043.

Four cases are described in which emphysematous bullae were demonstrated outside the pleura in the course of collapse therapy by artificial pneumothorax in pulmonary tuberculosis. In 2 of the cases the needle had probably stopped in the space between the parietal pleura and the thoracic fascia and the air had been insufflated directly outside the pleura. In the other 2 cases the point of the needle had probably entered the pleural cavity but as the needles were large or blunt, air had flowed back along the needle into the extrapleural space. In such cases roentgen examination will show the extrapleural localization of the air. The parietal pleura, being presented edgewise to the incident rays shows as an opaque line in the midst of the transparency of the pneumothorax. If the pleura is normal it is of capil-

lary thinness but if inflamed it is thicker. It is generally convex on the inside but may sometimes be ring-shaped, suggesting cavity. It is usually not difficult to differentiate an extrapleural bulla from a sacculated pneumothorax as the latter is bounded on the inside by lung parenchyma.

If an extrapleural effusion of gas is not recognized, the insufflation of more air into it, forcing the pressure, may cause generalized emphysema and death; if it is not forced and only a small extrapleural pressure is kept up, the pressure is not sufficient for therapeutic purposes. The old lesions may be reawakened and progress. The damage is still greater if the expansion of the parenchyma brings the visceral pleura into contact with the parietal, resulting in adhesions which prevent further pneumothorax treatment.

To avoid these extrapleural accumulations of air, care should be taken to see that the point of the needle is inside the pleural cavity before the insufflation is begun and to use small, cutting needles, not large blunt ones.—*Audrey G. Morgan.*

KING, D. S., and LORD, F. T. Certain aspects of pulmonary abscess from an analysis of 210 cases. *Ann. Int. Med.*, Oct., 1934, *8*, 468–473.

The authors record the study of 210 cases, all but one of which have been followed to the termination in death or present condition from two to nine years after discharge. Two of every 3 cases occurred under such circumstances as to make it reasonable to assume that the abscess arose in consequence of access to the lung of infected material from the upper respiratory tract.

Bronchoscopy was performed in 72 instances and should be considered in all cases with localized pulmonary suppuration. It is especially indicated where there is evidence of bronchostenosis to determine presence or absence of a foreign body or tumor. Seventeen cases only were studied by contrast medium bronchography and the method is considered principally of value to differentiate lung abscess and bronchiectasis.

Treatment is discussed in detail and the statistics of the present study are presented.—*W. R. Brooksher.*

TOUROFF, ARTHUR S. Infrapulmonary pyopneumothorax. *J. Mt. Sinai Hosp., N. Y.*, Nov.–Dec., 1934, *1*, 161–165.

A case of pyopneumothorax, encapsulated between the diaphragm and the base of the lower lobe, which resulted from necrosis of an area of probable pulmonary infarction, in a patient with cardiac decompensation, is reported. The roentgenograms, although simulating those seen in cases of subphrenic abscess, were quite characteristic. In the region of the right base a collection of fluid surmounted by air was seen. Above the collection of air a transverse band was noted which resembled the diaphragm, thus giving the appearance of a subphrenic abscess containing gas. However, pulmonary markings could be seen superimposed on the air, thus establishing the band as being the base of the lower lobe rather than the diaphragm. The lower lobe had been elevated and compressed by a pyopneumothorax which lay between the under surface of the lobe and the diaphragm. The diaphragm lay at a lower level and was obscured by the collection of fluid. Following graded surgery, the patient made rapid improvement, and final roentgen examination showed full expansion of the lower lobe with a small residual pleural thickening at the operative site.—*W. R. Brooksher.*

SCHWARZMANN, A. Über generalisierte carcinomatöse Lymphangitis der Lungen. (Generalized carcinomatous lymphangitis of the lungs.) *Acta radiol.*, 1934, *15*, 491–501.

Two cases of generalized carcinomatous lymphangitis of the lungs are described. This disease is by no means rare. The development of the disease is determined not so much by the location of the primary tumor as by the cancerous infiltration of the lymph glands of the hilus. This blocks the lymphatics of the lung, and brings about cancerous infiltration of the lung tissue. The findings on auscultation and percussion in carcinomatous lymphangitis are by no means characteristic, but the roentgen picture is very typical. It shows dense hilus shadows and accentuation of the normal lung outline. There is a network of fine meshes with scattered foci of greater opacity. As a rule, the upper third of the lung is almost free of changes, while the lower two-thirds are very severely affected. The author discusses the differential diagnosis of these changes from those of other disseminated processes in the lung and says that the diagnosis of carcinomatous lymphangitis cannot be definitely established from the roentgen picture unless the primary tumor is demonstrated and there is dyspnea.—*Audrey G. Morgan.*

Stewart-Harrison, R. Mediastinal tumours and leucaemia. *Acta radiol.*, 1934, *15*, 539–548.

There are two special groups of mediastinal tumor which show a particularly bad prognosis. The first group are tumors which at first have a normal blood picture or at least an aleukemic one, but later develop a leukosis. The author uses the term "leukosis" to describe the disease (lymphadenosis or acute or chronic myelosis) and leukemia or aleukemia to describe the condition of the blood in order to avoid using the contradictory term aleukemic leukemia. The other group is classic lymphosarcoma of the mediastinum. It is impossible to make a differential diagnosis between these two groups in cases in which the blood formula is normal. The author thinks it possible that the etiology of the two diseases is the same, but this cannot be determined definitely until the etiology is more thoroughly understood.

Radiotherapy is of value in the treatment of these conditions but it must be used very cautiously as the process may even be hastened by irradiation if not carefully given but as there is absolutely no hope other than from radiotherapy the use of this treatment is justifiable. Cases that are aleukemic in the beginning and develop a leukosis all end in death. The prognosis is not so hopeless in mediastinal lymphosarcoma. In the stage when differential diagnosis is impossible the condition must be considered lymphosarcoma and treated as such. —*Audrey G. Morgan.*

Gliozzi, Saverio Maria. Contributo allo studio dell'enfisema mediastinico. (Mediastinal emphysema.) *Radiol. med.*, Aug., 1934, *21*, 974–983.

The author reviews the discussion in the literature with reference to the visibility of the mediastinum, independently of its contents, in the roentgenogram. He then describes a case of his own in a woman of twenty-nine who was given artificial pneumothorax. During the first insufflation the patient felt pain, constriction of the throat and palpitation of the heart for an hour or two after the filling. On the sixth insufflation she felt these symptoms, and a moderate degree of subcutaneous emphysema developed in the right supraclavicular region and later in the left supraclavicular and supraspinous regions. There was no emphysema of the neck.

Roentgen examination showed two decided lines of shadow, one on the right and one on the left of the cardiovascular shadow and about two fingers' breadth from it. They extended down to the diaphragm and up into the apical region. They approached the heart shadow simultaneously and symmetrically during inspiration, while on expiration they moved away from it, looking, the author says, like two veils blown by the wind; they were concave toward the midline. The excursions of the lines were made in small successive movements. The space between the two lines was very transparent and its transparency increased on inspiration. These lines were doubtless the shadow of the thickened mediastinal pleura taken in profile. There was also an area of marginal pneumothorax along almost the whole length of the left half of the thorax. On rest the mediastinal shadows and this left pneumothorax disappeared in about ten days.

The gas probably entered the mediastinum through a slight laceration in the pleura from rupture or traction on adhesions. It was rather remarkable that the subcutaneous emphysema was so slight, being absorbed in two days, while the mediastinal emphysema was so much more marked, requiring ten days for absorption. There must have been some septum preventing the gas from rising from the mediastinum into the deep tissues of the neck as there was no emphysema there. The relatively slight symptoms must have been due to the fact that the opening was small and the mediastinum was able to adapt itself to the gradual entrance of the air, in contrast with the very severe symptoms seen in traumatic mediastinal emphysema.—*Audrey G. Morgan.*

Lupacciolu, Giovanni. L'arteriografia negli aneurismi dell'aorta toracica. (Arteriography in aneurysm of the thoracic aorta.) *Radiol. med.*, July, 1934, *21*, 819–841.

The author describes 2 cases of arteriography in subjects with aneurysm of the thoracic aorta. He injected a solution of sodium iodide into the thoracic aorta in one case and into the left ventricle in the other, under a pressure of 1,800 kilograms in the one case and of 2,200 kilograms in the other. He was able to demonstrate the sac of the aneurysm in both cases. In the second case not only was the sac of the aneurysm shown but also the innominate artery and the subclavian and axillary arteries. He describes the technique of the injections and says that if this method is to be used the patient should be selected with some care. His patients were sixty-two and seventy-eight years of age,

and both had signs of general arteriosclerosis. The second patient suffered severe shock from the injection from which, however, he recovered in a few hours. The author believes, however, that the method is hardly practical in its present stage of development because of the danger to which it exposes the patient. Nevertheless he believes that arteriography of the heart and thoracic aorta may be rendered practical if a contrast medium can be found with the necessary properties of very great opacity, small volume, and complete freedom from toxicity.

An extensive bibliography of the subject is given.—*Audrey G. Morgan.*

TAYLOR, ELIZABETH F. Coarctation or congenital stenosis of the aorta. *Brit. J. Radiol.*, Aug., 1934, *7*, 452–462.

Five cases are reported with a discussion of the etiology, types, associated anomalies, secondary changes and collateral circulation. The points in roentgen diagnosis are: (1) hypertrophy of the left ventricle in 75 per cent of the cases; (2) the aortic knuckle, or the shadow representing the third part of the arch of the aorta, is missing; (3) there is aneurysmal dilatation of the first part of the aortic arch in over 50 per cent of the cases; (4) erosion of the under surfaces of the ribs is present in nearly all cases, and (5) the bifurcation of the trachea is said to be seen pencilled out in the left anterior oblique position.—*W. R. Brooksher.*

HORINE, C. F., and WARNER, C. G. Experimental occlusion of the pulmonary artery; an anatomic study. *Arch. Surg.*, Jan., 1934, *28*, 139–149.

Roentgenographic and histological studies were made on dogs and rabbits after ligation of one or more branches of a pulmonary artery. As early as forty-eight hours there developed a shift of the heart and mediastinum to the occluded side. There were seen scattered areas of emphysema, particularly throughout the lung supplied by intact vessels, and areas of atelectasis with many sites of hemorrhage into the air sacs of the parenchyma of the occluded regions. The right side of the heart showed considerable dilatation. Months after the ligations, prominent subpleural vessels were found. These were demonstrated to have connection with the bronchial vessels and were considered to be a compensatory vascular mechanism. Relatively little fibrosis developed and no collateral circulation was established by way of the parietal pleura.—*A. A. de Lorimier.*

MARINI, BENEDETTO. La diagnosi radiologica della pericardite essudativa. (Roentgen diagnosis of exudative pericarditis.) *Arch. di radiol.*, 1934, *10*, 189–207.

In some cases diagnosis of exudative pericarditis is easy while in others it is extremely difficult. The pericarditic effusion is not visible unless there is at least 400 c.c. of fluid. The first roentgen sign is an enlarged heart with a roughly triangular form. In some cases the deeper shadow of the heart can be seen inside the shadow of the effusion. The picture of an enlarged and flabby heart is, however, similar to that of pericarditis with effusion.

There are various technical maneuvers that help in the diagnosis. The first of these is change of position of the patient. In pericarditis with effusion the liquid changes its position, changing the form of the heart outline. Another method is insufflation of the stomach with gas. The lower outline of the heart becomes more clearly visible in contrast with the gas. In pericarditis with effusion the lower outline of the heart remains motionless while in the hypotonic heart weak pulsations can be seen. Valsalva's manipulation also causes an increased intrathoracic pressure, resulting in flattening of the shadow of the hypotonic heart while the heart shadow is not changed in pericarditis. If the patient is required to make a considerable effort the normal heart reacts with a decrease in size, the hypotonic heart shows an increase and the pericarditic heart remains unchanged. If the circulation of the limbs is excluded there is a transitory dilatation followed by systolic contraction in the normal heart, the initial dilatation is marked with tachycardia and arrhythmia in the hypotonic heart which tends to persist while there is no change in the pericarditic heart unless it is accompanied by myocarditis with hypotonia. In the latter case there will be tachycardia and arrhythmia.

The author describes and illustrates with roentgenograms 4 cases of pericarditis with effusion in which these aids in diagnosis had to be used. None of them alone is absolutely conclusive; they have to be studied together and in connection with the clinical signs. The best method of making a sure diagnosis is to examine several times at intervals of several days. If after some days there is a marked increase in the shadow without serious signs of

decompensation pericarditis is certain. If with rest the shadow decreases considerably it also indicates pericarditis. The dilated heart decreases in size only very slowly. As a last resort the diagnosis may be made by exploratory puncture.—*Audrey G. Morgan.*

Sticotti, Stelio. Formazioni nodulari sulla pleura parietale di ammalati pneumotoracizzati. (Nodules on the parietal pleura in artificial pneumothorax.) *Radiol. med.*, April, 1934, *21*, 424.

Two cases are described in which the patients were treated by artificial pneumothorax following pleurisy. Roentgen examination some months later showed nodules on the parietal pleura. Both cases went on to recovery so the nodules were evidently not a manifestation of disease of the pleura. They were probably caused by deposits of fibrin on the pleura which were particularly thick in these two cases.—*Audrey G. Morgan.*

Walther, Hans E. Eine Methode der Ortsbezeichnung im sagittalen Röntgenbild der Lungen. (A method of localization in sagittal roentgenograms of the lungs.) *Acta radiol.*, 1934, *15*, 417–422.

The author describes a method which enables the roentgenologist to locate changes in the roentgenogram of the thorax very simply and accurately. He divides the pulmonary area into about two dozen rhomboid fields by means of shadows of the ribs. By prolonging the anterior outlines of the ribs the hila are divided into from six to eight fields, which suffice for simple localization in that area.—*Audrey G. Morgan.*

ABDOMEN

Luppaciolu, Giovanni. In caso di ernia diaframmatica sinistra del colon. (A case of left diaphragmatic hernia of the colon.) *Radiol. med.*, May, 1934, *21*, 594–604.

A patient thirty-nine years of age had dry pleurisy on the right side in 1930. He had another attack in January, 1932, after which he began to complain of diffuse pain in the abdomen and for the past year had had intense palpitation of the heart, particularly when he lay down at night. His physician sent him for roentgen examination with a diagnosis of sequels of pleurisy on the right side and dyspnea. Roentgen examination showed a large gas bubble in the left half of the thorax in front of the heart which appeared to be colon as it showed haustra. A roentgen enema confirmed the diagnosis. The colon could be seen passing through a very small opening in the left diaphragm which compressed it until it was almost entirely occluded. The colon was restored to its proper position by operation and the patient made an uneventful recovery.

There was no possibility of mistaking the diagnosis in this case. In some cases differentiation has to be made from intrathoracic stomach, diverticula of the stomach and eventration of the diaphragm.—*Audrey G. Morgan.*

Vietor, Agnes C. Anatomic basis for the study of splanchnoptosis. *Arch. Surg.*, April, 1934, *28*, 659–683.

This report is a sequel to previous studies by the author on descent of the viscera. These observations concern the progressive gravimetric effects after releasing supporting structures. The fundamental step in splanchnoptosis is believed to be "incompetence of the abdominal walls, due to failure in the development or coordination of the complex reflexes." The author has noted first a forward projection of the viscera, then descent with traction of the associated elements and regional viscera. The kidneys, stomach, redundant portions of the colon, the liver, the lungs and the heart were found to be the most easily displaced. The adrenals were found to be early elongated by descent of the kidneys but they were finally separated and remained approximately fixed. The stomach descended downward, forward and to the right, producing traction, perhaps pressure, kinking, torsion or obstruction of the first portion of the duodenum. Unfolding of the loops of the transverse colon caused it to descend with the production of kinking and stasis at the angles, and perhaps traction on the stomach, duodenum and neck of the gallbladder. The liver, though comparatively fixed, was subject to forward, backward and lateral rotations. Traction on it produced elongation and modification in its shape. Even the lungs were found to alter their shape with changes in the thoraco-diaphragmatic relations. The heart was found to be relatively fixed at its base, but its apex readily movable from left to right and in downward rotation.—*A. A. de Lorimier.*

Ottonello, Pietro. L'importanza dell'esame radiologico per la diagnosi dei tumori addominali. (The importance of roentgen examination in the diagnosis of abdominal tumors.) *Radiol. med.*, June, 1934, *21*, 678–688.

The author describes a case of large dermoid cysts of the right ovary, which was diagnosed by roentgen examination confirmed by operation. The patient's last pregnancy, which had ended in delivery forty-five days before she came for examination, had been normal. After the delivery the midwife noticed an abdominal tumor which she attributed to a second fetus. Gynecological examination and the arrangement of the loops of the intestines in the roentgenogram seemed to indicate that the cyst did not belong to the ovary, but this was explained by the fact that it had a long pedicle. There were opaque nodules in the shadow of the cyst, distinctly different from the opacities due to calcification, which are somtimes seen in fibromyomata or hydatid cyst. Such opaque shadows, even if they do not show the typical appearance of teeth, suggest a roentgen diagnosis of dermoid cysts.—*Audrey G. Morgan.*

BUISSON, PAOLO. Sul problema dell'evacuazione vesicolare. (Evacuation of the gallbladder.) *Radiol. med.*, April, 1934, *21*, 392–404.

The author discusses the value of cholecystography in studying the physiological function of the gallbladder. There has been a great deal of discussion as to the mechanism of emptying of the gallbladder and there is by no means unanimity of opinion in regard to it yet. He believes that emptying is brought about by active contractility of the gallbladder itself. He studied it by giving a meal of three egg yolks which is a very active stimulant of gallbladder activity. After giving this meal he found that the hepatic duct filled at the same time with the filling of the gallbladder and the cystic duct. This retrograde filling of the hepatic duct he considers absolute evidence of active contractility on the part of the gallbladder. It shows not only closure of the opening of the common duct into the duodenum by contraction of Oddi's sphincter and filling of the common duct to its maximum capacity but a vis a tergo which could not be supplied by anything else but contraction of the gallbladder. The theory of aspiration by the common duct could not apply because it could not aspirate the gallbladder contents into the hepatic duct which lies above it.—*Audrey G. Morgan.*

DEMOLE, MICHEL. Les retards de remplissage en cholecystographie. (Retardation of filling in cholecystography.) *Acta radiol.*, 1934, *15*, 423–437.

There is no doubt that the liver plays an important part in the distribution of the tetraiodide to the external bile tract in cholecystography. Therefore, if liver function is impaired there is a delay in the filling of the gallbladder. The ordinary method of cholecystography, however, only shows whether the gallbladder fills and therefore becomes visible. It does not become visible until after some fourteen hours so that retardation due to impaired liver function is not perceptible. Antonucci has devised a method of cholecystography which differentiates between the liver and gallbladder factors in filling. He injects glucose immediately before the tetraiodide. This stimulates the cholagogue function of the liver and the gallbladder becomes visible in normal cases in from one and a half to two hours. If there is some impairment of liver function visibility develops later, the length of the delay depending on the degree of impairment of liver function. Even slight abnormalities of liver function can be demonstrated in this way. Clinical cases and roentgenograms are given in evidence of these statements.—*Audrey G. Morgan.*

DE QUERVAIN, F. Bemerkungen zur klinischen Wertung des Röntgenbildes. (Clinical evaluation of the roentgenogram.) *Acta radiol.*, 1934, *15*, 409–416.

The author has compared the roentgen and surgical findings in 352 cases of operation on the stomach, and finds that in 4.5 per cent of these cases there was disagreement between the roentgen diagnosis or the tentative diagnosis based on the roentgenogram and the facts as shown by operation. It is true that a part of his material was from a period before serial roentgenography of the duodenum had come into general use, but he says that even with the improved diagnostic technique of the present day such errors might occur in at least 2 per cent of the cases. He also studied the question of discrepancies between the roentgen findings and the history and the results of examination of the stomach contents. In doubtful cases either the history or the examination of the stomach contents indicated the correct diagnosis, but even there there was sometimes disagreement. The roentgenogram can have its greatest value only when the roentgenologist and clinician cooperate intelligently, and when the latter is able to make use of all other aids in diagnosis to supplement his own clinical conclusions.—*Audrey G. Morgan.*

Rosselet, A., and Mengis, O. Sur une anomalie congénitale de l'estomac. (A congenital anomaly of the stomach.) *Acta radiol.*, 1934, *15*, 438–442.

A woman of fifty had suffered from indigestion since childhood. In recent years she had suffered from distention of the stomach, particularly after certain kinds of food, and in 1930 this distention became painful. It was never accompanied by vomiting. Roentgen examination showed the esophagus elongated and its lower end at the cardia situated about 20 cm. below the diaphragm on the posterior surface of the stomach. The bulb of the duodenum was fixed in a high position against the posterior surface of the stomach, about 15 cm. below the diaphragm on a line parallel to the midline, and about 3 cm. to the left of it. The authors believe that this torsion and descent of the stomach was not caused simply by congenital laxity of the normal mechanism of fixation, but was caused by the fact that the duodenum had not undergone either its normal movement of descent into the abdominal cavity or its normal movement of rotation from left to right in the frontal plane.—*Audrey G. Morgan.*

Giraudi, Gioffredo. Sui polipi adenomatosi e pseudo-adenomatosi dello stomaco e dell' intestino. (Adenomatous and pseudo-adenomatous polyps of the stomach and intestine.) *Radiol. med.*, Sept., 1934, *21*, 1003–1030.

Many neoplasms of the gastrointestinal tract may assume a polypous form. There has been a great deal of discussion as to whether polyps of the intestinal tract are really tumors or inflammatory in nature. Both forms probably occur. Some polyps are doubtless true adenomata and others products of inflammation. Some of them undergo malignant degeneration, the percentage given by various authors varying from 20 to 50.

Among the prominent symptoms of polyps of the intestinal tract are entorrhagia, diarrhea and rectal symptoms including prolapse of the rectum, difficult defecation and tenesmus. Among the frequent complications are invagination of the intestine, carcinomatous degeneration and in many cases infantilism and hippocratic fingers.

Intestinal polyps are best demonstrated by means of small contrast enemas which show the mucous membrane relief or by the combined method of insufflation with air and an opaque enema. The polyps may be hidden with complete contrast filling. A good way to demonstrate them is to siphon off the enema by degrees, keeping the patient under screen observation. The polyps cause filling defects and if taken in profile the pedicle may be distinctly seen. If the polyps are multiple they may give a honeycomb image. Polyps may be simulated by fecal residues mixed with contrast medium and by solid residues of food such as peas, fruit seeds, etc. The roentgenogram may also show signs of inflammation such as stricture of the lumen, disappearance of the haustra, etc., and complications such as intussusception and malignant degeneration.

Polyps of the stomach may also be shown by the ingestion of a small amount of paste and graduated compression or by the combined method of ingestion of a barium meal and insufflation with air. The roentgenogram sometimes shows a valve occlusion of the pylorus by a polyp. Stomach polyps may be simulated by physiological or pathological mamelonated conditions or by various food residues.

The author describes 4 cases and illustrates them with roentgenograms. The first was one of adenomatoid polyps due to inflammation of the rectum and sigmoid colon accompanied by periproctitis and perisigmoiditis. In the second case a carcinoma of the cecum was associated with polypous tumors of the ileum and large intestine. In the third case a diffuse polyposis of the stomach with a "sponge" image had probably given rise to the development of the carcinoma which was seen in the pyloric region. The fourth case was one of polypous duodenitis, the cause of which was obscure.—*Audrey G. Morgan.*

Picchio, Carlo. Contributo allo studio radiologico dei tumori del fornice gastrico. (Roentgen study of tumors of the fornix of the stomach.) *Radiol. med.*, July, 1934, *21*, 793–813.

The author discusses the technique of examination of tumors of the fundus of the stomach and says that it does not present any greater difficulty than that for tumors in any other part of the stomach. One valuable method is to observe the gas pouch of the stomach without the introduction of any contrast medium. In this way the opaque image of the tumor can often be seen directly in the transparent gas. The form and distensibliity of the gas pouch are also important elements in diagnosis. Another

sign of tumor is thickening of the shadow which separates the transparency of the gas from that of the lungs. The way in which the opaque liquid descends into the stomach with the patient standing should also be observed carefully. If there is tumor the opaque fluid shows deviations and irregularities in its course and subdivision into secondary streams. It descends along the lesser curvature in a stairsteps fashion and sometimes turns upward again and covers the walls of the fundus. The tumor changes the appearance of the normal mucous membrane relief of the stomach, producing irregular transparent areas in it, separated by branching opaque sulci. The study of mucous membrane relief is valuable in determining the size of the tumor and particularly for showing the boundary between normal and pathological tissue. By completely filling the fundus with contrast fluid, filling defects and irregularities in the outline of the fornix can be seen. The methods of examination may be supplemented by stereoroentgenograms, which are valuable in differential diagnosis.—*Audrey G. Morgan.*

COMFORT, MANDRED W., and VANZANT, FRANCES R. Gastric acidity in carcinoma of the stomach. *Am. J. Surg.*, Dec., 1934, *26*, 447–456.

The gastric analyses of 619 men and 186 women with proved gastric carcinoma were studied by a new statistical method. Achlorhydria showed an incidence of three times normal with the mean free acidity lowered about 14 units in men and 8 in women. In those patients who had free acid, the total acidity was only slightly lower than normal. In those without acid, the total acidity was slightly above normal. No marked influence was exerted upon gastric acidity by the degree of the anemia, loss of weight, situation of the tumor, or the volume of gastric contents. The marked differences in gastric acidity which were observed when the lesions were divided into ulcer-like, pseudo-ulcer, or non-ulcer type of history are detailed. —*W. R. Brooksher.*

BEVILACQUA, LUIGI. Contributo radiologico ed istologico alla interpretazione dell' "immagine ad anello" nell' ulcera gastro-duodenale. (Roentgen and histological interpretations of the "ring image" in gastroduodenal ulcer.) *Radiol. med.*, June, 1934, *21*, 668–678.

Ring-shaped shadows appear in some cases of gastroduodenal ulcer. These have been interpreted differently by different authors. Salotti says that they are formed by an accumulation of barium in the bottom of an ulcer crater, arranged in the shape of a ring around a central transparent area. The author describes a case in a young man twenty years of age, in which the duodenal ulcer showed such a ring. The ulcer was resected. The anatomical specimen showed an elevated ring with sulci radiating out from it corresponding to the rosette image seen in the roentgenogram. In the center there was a little projecting cone. Histological examination showed that it was caused by newformed connective tissue, developing in the base of the ulcer crater, which had undergone degenerative and necrotic changes. It is possible that the etiology of the these ring-shaped shadows is not uniform and that they may be due to other causes in other cases.—*Audrey G. Morgan.*

VOLPE, VITO. Identici quadri radiologici di una compressione estrinseca dell'antro gastrico, dovuti a processi morbosi aventi sede diversa. (Identical roentgen pictures from external compression on the antrum of the stomach caused by pathological processes at different sites.) *Radiol. med.*, June, 1934, *21*, 710–715.

The author describes 2 cases which show identical roentgen pictures of external compression on the antrum of the stomach. In the first case, however, the pressure was exercised by a hydatid cyst on the lower surface of the liver. In the second case it was caused by a retroperitoneal tumor, which probably originated from the body of the pancreas. The author thinks the resemblance is due to the fact that in the second case the retroperitoneal tumor followed an unusual route, that is, it developed above the stomach pushing the lesser omentum in front of it. In this way it caused pressure on the antrum, just as a cyst on the lower surface of the liver would have done.

These cases show the difficulty in diagnosing the cause of pressure on the lesser curvature of the stomach and the antrum.—*Audrey G. Morgan.*

BARBACCI, GINO. Su la diagnosi delle immagini diverticolari dell'angolo duodeno-digiunale. (Diagnosis of diverticula of the duodenojejunal angle.) *Radiol. med.*, April, 1934, *21*, 428–432.

Two cases of diverticulum of the duodenojejunal angle are described. In one there were no symptoms of the condition. The patient had come for examination for diffuse pain in the right side of the abdomen and chronic constipation. As soon as the contrast medium had passed the duodenojejunal flexure a small shadow appeared, about the size of a hazelnut, which could hardly be interpreted as anything else than diverticulum of the duodenojejunal flexure. In the other case, however, the patient had had symptoms for years that strongly suggested gastric ulcer. The roentgenogram showed an opaque spot about 2 cm. to the right of the lesser curvature and 1 cm. above the duodenojejunal angle. Examination in the right anterior oblique position showed that it was posterior to the stomach but not so far that it might not be connected with it. With the patient lying on his back the shadow was entirely covered by the stomach shadow. By pressing the contrast medium from the antrum of the stomach into the duodenum and then, with pressure above and below the duodenojejunal flexure, forcing the paste in the direction of the flexure, the diverticulum was seen to fill, showing its true site. This illustrates the technical measures that may have to be used to localize these diverticula accurately. This patient refused operation and in the course of a year improved somewhat on careful diet.

These diverticula generally do not cause any symptoms unless they become inflamed and even then the symptoms are by no means characteristic.—*Audrey G. Morgan.*

Fratini, Carlo. Rilievi radiologici e controllo operatorio in casi di ulcera gastro-duodenale trattati col banzoato di sodio. (Roentgen findings and operative control in cases of gastroduodenal ulcer treated with benzoate of soda.) *Radiol. med.*, June, 1934, *21*, 653–668.

Thirteen cases of gastroduodenal ulcer are described which were treated with sodium benzoate and pepsin. In 9 of the cases the results of treatment were followed up by roentgen examination and in the other 4 operation was performed. From the results of his observations, the author concludes that this treatment has no effect on the roentgen picture and therefore no effect in healing the ulcers. He finds, however, that these drugs do, to a certain extent, control spasm and therefore relieve pain. —*Audrey G. Morgan.*

Bistolfi, Stefano. Per una piu completa demonstrabilita radiologica del bulbo duodenale; il pasto opaco serale di controllo. (Use of a supplementary late afternoon opaque meal for more complete roentgen demonstration of the bulb of the duodenum.) *Radiol. med.*, May, 1934, *21*, 495–522.

Maragliano was obliged in some cases to make an examination of the digestive tract in emergency cases in the afternoon soon after the digestion of an ordinary meal rather than at the usual time in the morning with the stomach empty. He found in these cases even better visibility of the bulb of the duodenum than usual. The author, therefore, tried the plan of making a supplementary examination for lesions of the duodenum after the digestion of an ordinary or even a rather heavy noon meal in addition to the usual morning examination with the stomach empty.

He has used the method in 40 normal subjects and 400 patients with various lesions of the digestive tract. He finds that in 60 per cent of the normal cases there is better visibility of the bulb of the duodenum after the second meal. Though the difference in the morning and afternoon findings is not so great in cases of ulcer, still the author believes that is it worth while making the second examination as an aid in more certain diagnosis. In spasmodic conditions of the bulb resulting from lesions in other parts of the digestive tract spasm is eliminated by the second meal.—*Audrey G. Morgan.*

Piergrossi, Aldo. Diverticoli duodenale. (Duodenal diverticula.) *Radiol. med.*, Aug., 1934, *21*, 875–916.

Typical diverticula of the duodenum may be located either in the lateral recess of the bulb, at the papilla of Vater, the concavity of the lower flexure or the duodenojejunal angle. Other forms are atypical in size and localization. Cases of these various forms are described and illustrated with roentgenograms. These diverticula do not cause any characteristic symptoms unless they become inflamed but they may undergo the same pathological changes as the appendix, and they are frequently accompanied by other diseases, chiefly duodenal ulcer, angiocholecystitis, pancreatitis and appendicitis.

When the diverticulum becomes diseased it may give rise to six types of symptoms: (1) the dyspeptic type; (2) the ulcerous type; (3) the type resembling stenosis of the pylorus with

vomiting; (4) the angiocholecystitic type, attributable more to the accompanying cholecystitis than to pressure by the diverticulum; (5) the pancreatic type with pain, steatorrhea, diarrhea and cachexia; (6) the appendicial type attributable directly to the diverticulum.

Duodenal diverticula cannot be diagnosed by brief roentgenoscopic examination. Roentgenographic diagnosis requires careful technique and careful weighing of the clinical data in connection with the roentgenographic findings. Case has suggested a special technique for obtaining a good view of diverticula of the first and second portions of the duodenum. The patient is placed in right lateral decubitus, in which position the diverticulum fills well. The patient inspires deeply and while the examiner presses the duodenum against the spinal column with his hand, exercising manual compression of the antrum if possible, the patient turns on his back. In this way both the duodenum and diverticulum remain filled with contrast. Examination by graduated compression is valuable in many cases in exploring the folds of the neck and fundus of the diverticulum, but it is ineffective if the diverticulum is located in the head of the pancreas. Examination should be made to see whether the pancreas is enlarged. The entire digestive tract should be examined to detect any possible associated diseases.

The general characteristics of diverticulum are a shadow with distinct outlines when filling is perfect, in or near the duodenum; passage of part of the paste beyond the shadow into the following parts of the intestine; persistence of the shadow after the duodenum is emptied and permanence of the shadow for some hours or even some days. According to Bonneau the shadow of a diverticulum has three characteristic features: insensitiveness on pressure, displacement on palpation and persistence. Generally on respiration it follows the movements of the segment of the duodenum in which it is located; if it is perivaterian or intrahepatic it moves with the second portion, which confirms the mobility of the pancreas. Diagnosis of the site of the diverticulum is particularly difficult. The oblique or lateral projections help to demonstrate the segment of the duodenum in which it lies but are rarely sufficient to show whether it lies in front of, behind or inside the pancreas, and this is important, as operation is difficult and often not advisable in intrapancreatic diverticula.

Medical treatment is merely symptomatic. Diverticula should be operated on if they cause symptoms. The operation may be simple gastroenterostomy, excision or burying of the diverticulum, which may or may not be followed by gastroenterostomy, or resection of the duodenum. In intra- or retropancreatic diverticula or those at the duodenojejunal angle, it is sufficient to perform a gastroenterostomy to place the diverticulum at rest and cure the diverticulitis.—*Audrey G. Morgan.*

PERONA, P. I processi cronici e produttivi dell' ileo terminale studiati con le seriografe mirate. (Chronic and productive processes of the terminal ileum studied with aimed serial roentgenograms.) *Arch. di radiol.*, 1934, *10*, 145–181.

The author points out the many similarities between the stomach and the terminal part of the ileum in morphology, function and in the appearance of the mucous membrane relief. The terminal part of the ileum, like the stomach, may show either productive or regressive processes; in the chronic hypertrophic forms of gastritis or enteritis the mucosa is thickened and harder than normal with projecting ridges that give the walls a mamelonated appearance. In chronic atrophic gastritis or enteritis the mucous membrane is thinned and smooth and the connective tissue sclerotic. In the productive forms the mucous membrane folds are elongated and tortuous; in the atrophic form they may disappear altogether.

The mucous membrane relief has not heretofore been studied very thoroughly in the terminal part of the ileum but such a thorough study may be made by means of serial roentgenograms aimed directly on this part of the intestine. The article is profusely illustrated with such roentgenograms.

A catarrhal enteritis is very frequently associated with appendicitis and not infrequently simulates an appendicitis when the appendix is not involved. Differentiation may be made between the two conditions by means of the serial roentgenograms. Differential diagnosis can also be made in the same way between follicular enteritis and papillomatosis and between tuberculosis and tumors of the ileocecal region.—*Audrey G. Morgan.*

BRANCADORO, GIUSEPPE. L'importanza dell' esema radiologico nella diverticolosi del colon. (The importance of roentgen examination in diverticulosis of the colon.) *Arch. di radiol.*, 1934, *10*, 225–239.

Diverticulosis of the colon does not give characteristic symptoms, in fact rarely gives symptoms at all, unless the diverticula become inflamed. In that case the symptoms are apt to be confused with those of appendicitis, gastric ulcer, stenosis of the intestine, cholecystitis, perforation of gastroduodenal ulcer, etc. The only method of making a correct diagnosis is by roentgen examination. Even then careful technique and weighing of the evidence are necessary as images resembling those of diverticula may be produced by spastic haustra partially filled with gas, feces, foreign bodies, coproliths, etc.

Three cases are described and illustrated with roentgenograms. The clinical examination did not suggest diverticulosis in any of the cases. In one of them a diagnosis of perforated gastric ulcer had been made. Roentgen examination showed diverticula of the colon in all 3 cases. In 2 of them the technique used was that of a roentgen enema under low pressure, in the other the barium meal. No uniform technique can be used but a systematic examination should be made for diverticula in any case of abdominal disease with obscure symptoms, testing different techniques until the one adapted to the case is found.—*Audrey G. Morgan.*

Dall'Acqua, Virgilio, and Valsecchi, Romeo. L'aspetto radiologico della mucosa normale del colon. (The roentgen appearance of the normal mucosa of the colon.) *Radiol. med.*, July, 1934, *21*, 765–784.

By examining the mucous membrane relief of hollow organs the first signs of pathological change can be detected, as these first changes generally occur on the surface of the mucous membrane. This examination is made by distributing a thin layer of contrast medium over the inner surface of the organ. Careful technique is necessary to obtain a uniform distribution of the contrast in the colon. The patient is prepared by giving olive oil as a purgative for one or two days before the examination. Salines are too irritating. The diet should be chiefly liquid. The opaque enema is preceded by one or two cleansing enemas of warm water, the last one being given one or two hours before the opaqua enema to allow time for absorption of all the water. Either barium or colloidal thorium preparations may be used as contrast media. The fluid is allowed to flow in under low pressure to avoid spasm and over-expansion. If functional spasms occur at the sphincters they may be overcome by change in the position of the patient, or by massage. As soon as the cecum is filled the enema is stopped. It should not be over-distended as otherwise the last loop of the ileum may fill and interfere with the clearness of the pictures. Sometimes retrograde filling of the appendix takes place. If desired, this can be brought about by light massage over the cecal region The patient is first examined in a prone and then in a supine position. All the segments of the colon are examined in all projections, to get a three-dimensional image. For a special study of the rectum and sigmoid the patient may be examined standing. For examination with the walls of the intestine collapsed, only about 250 to 500 c.c. of contrast liquid is necessary. This merely fills the lumen without distending the walls. It is advisable, however, to make an examination first with the intestine distended in order to study the tonus of the walls, their distensibility, and elasticity, and any possible obstacles to distention. The colon is then examined again after evacuation of the opaque enema. Insufflation of gas may be useful as the supplementary method in examining stenoses or serious injuries of the walls. This generally obliterates the mucous membrane relief but shows cancer nodules or polyps very clearly.

A general roentgenogram of the whole colon is first taken and special segments are then examined. The use of the Potter-Bucky diaphram is indispensable in roentgenography of the large intestine.

In the normal living subject the mucous membrane presents a complicated network of folds which are not fixed and static, but change constantly adapting themselves to functional requirements. They are only to a very limited degree dependent on contractions of the muscularis propria. This active autoplastic capacity of the mucosa is a very important factor in digestion and in propelling the feces along the intestinal tract. It makes the mucosa a definite organ with a specific function, coordinate with that of the muscle layer.

Roentgenograms are given showing the normal mucous membrane relief of the colon at rest and in motion. The size of the folds, their number and their arrangement are affected by all the functional changes of digestion, such as turgor, secretion and the vascularization of the mucosa. The folds normally can be made to

flatten out and disappear by pressure from the outside. Under pathological conditions they may become rigid and inelastic. An arborescent appearance of the mucosa is seen in a transient stage between the resting and moving types. Longitudinal folds are the simplest form. The mucous surface is reduced in this form and there is only slight absorption. The function of these folds is to push the intestinal contents forward. They are seen chiefly in the descending colon and sigmoid and at the contraction rings. They may be seen in the descending colon and proximal sigmoid in association with the "braided ribbon" appearance in the distal sigmoid, and the arborescent type in the transverse colon. The transverse and arborescent folds are more complex and are seen in segments with greater functional activity, such as the cecum and ascending and transverse colons. In the rectum the folds are arranged longitudinally. Their caliber is larger than in the other segments of the colon. Knothe describes as physiological a type of relief which is rarely seen in normal subjects. It is the same as that described in the so-called irritative condition, but unlike that type it persists only for a few seconds and is then transformed into one of the types already described. Knothe believes that it is due to an energetic contraction of the whole musculature of the large intestine as a stimulus to defecation. It is called the contraction type.

In increased tonus of the vagus, whether spontaneous or brought about by drugs, there is a complicated design which Knothe calls the irritation or braided ribbon type. Gilbert and Kadrnka say, however, that the braided ribbon type is only a variety of the arborescent type caused by exaggerated neuromuscular tonus and not by inflammation. The authors agree with the latter opinion. Evacuation of the enema is preceded by general contraction of the musculature which gives a picture very much like that of the irritative type. In cases of this type, however, a careful examination should be made for pathological conditions. The authors observed an example of it in a case of transdiaphragmatic hernia of the left flexure of the colon.

The various forms of mucous membrane relief are illustrated by roentgenograms.—*Audrey G. Morgan.*

CUSHWAY, B. C. Chronic cicatrizing enteritis. Regional ileitis (Crohn). *Illinois M. J.* Dec., 1934, *66*, 525–532.

The etiology, pathology and symptomatology of this rather characteristic clinical picture is discussed. In most instances the pathological process is characterized by a chronic proliferative inflammatory reaction in which the outstanding features are extensive mucosal ulcerations with thickening of the wall and constriction of the lumen of the bowel. As these lesions have been reported in locations other than the terminal ileum, "chronic cicatrizing enteritis" is doubtless a more descriptive term than is "regional ileitis."

Roentgenology offers the only preoperative diagnosis but the condition may not be recognized unless the clinical symptoms suggest its presence and serial roentgenoscopic study is carried out. Early in the disease delay and stasis in the small bowel with dilatation of the terminal ileum will be demonstrated. Later, as stenosis develops, there will be definite evidence of obstruction. Deformity of the ileocecal region may be noted. Negative findings with the opaque meal and enema in the presence of symptoms indicative of ulcerative colitis or tuberculosis are suggestive of cicatrizing enteritis. Milder degrees of stasis at the four, six, and nine hour observations may be overlooked if the roentgenologist does not consider the possibility of the condition. Differentially, one must consider, ulcerative colitis, ileocecal tuberculosis, typhlitis, actinomycosis, lymphosarcoma, intestinal or mesenteric tuberculosis, Hodgkin's disease and malignancy. Surgical resection is the treatment of choice. Three cases are reported, 2 proved pathologically.—*W. R. Brooksher.*

SPARKS, J. V., and EVANS, COURTENAY. Radiography of calcification in cardiac valves during life. *Brit. J. Radiol.*, Aug., 1934, *7*, 463–466.

The clinical and roentgenological findings in a case presenting calcification of the cardiac valves is discussed. Rotating the patient into the semi-oblique position under the screen demonstrated a well-marked, comma-shaped area of calcification in the position of the aortic valve. The roentgenograms presented were taken with 100 ma., 1/25 second exposure at a distance of 24 inches. The origin of the coronary arteries from the sinuses of Valsalva of the aortic valve furnishes a landmark for anatomical localization of the roentgen findings. Experimental work is being conducted with a view to determining if the usual distribution of these

vessels may be mapped out and thus localize small areas of calcification as being in the course of these vessels. Calcification of the valves may be present in the nodular type described by Monckeberg, or in a lesser degree associated with atheroma or as the result of valvulitis—rheumatic, subacute bacterial or syphilitic. —*W. R. Brooksher.*

Walther, Hans E. Die Darstellung der untersten Partien des Dickdarmes im Röntgenbild. (Demonstration of the lowest parts of the large intestine in the roentgenogram.) *Acta radiol.*, 1934, *15*, 488–490.

Roentgenograms of the lower part of the large intestine, the sigmoid and rectum, are generally taken in the sagittal direction, if possible in the abdominal position. This is the poorest projection for demonstrating this part of the intestine. Other parts of the intestine are projected over the parts to be examined, and it is hard to see the relation to the other organs of the pelvis. In films taken from right to left the shadows of the pelvic bones are superimposed over the intestinal picture. The author has succeeded recently in taking profile pictures of the rectum and sigmoid. He has found that there are two chief types of this part of the intestine, in one the part of the intestine above the sigmoid flexure runs horizontally forward and then passes into the descending colon at an angle of about 70°, in the second type the horizontal part of the intestine hangs downward in the shape of a garland, and forms a figure similar to the sigmoid flexure.

The method is as follows: The patient lies on the left side, the central ray being directed toward a point about 5 cm. dorsally from the anterior superior spine of the ilium. The radiation must be hard, about 85 kv., and the exposure time should not be more than 0.3 seconds. It is very important to fill only the lowest part of the intestine in order to avoid superposition. Not more than 200 c.c. of a concentrated barium emulsion should be used.

Roentgenograms are given showing stricture of the rectum, papillomatous tumors in the region of the sigmoid flexure, and stenotic carcinoma of the sigmoid flexure demonstrated by this method.—*Audrey G. Morgan.*

### GYNECOLOGY AND OBSTETRICS

Menees, Thomas O., and Miller, J. Duane. Demonstration of the relief of the endometrium with thorium hydroxide sols. *J. Mich. M. Soc.*, Nov., 1934, *33*, 598–601.

The authors report a method of roentgen diagnosis of intra-uterine lesions by the demonstration of endometrial relief using thorium hydroxide sols. The preparation of the solution and the technique of injection into the uterine cavity are detailed. The procedure assists in the localization and diagnosis of intra-uterine lesions, particularly the smaller ones. A more accurate selection of cases for irradiation and operative therapy and possibilities for the control of radiation therapy are offered by its employment.—*W. R. Brooksher.*

Fortier, L. A., and Gately, T. T. Pneumoperitoneum concurrent with paracentesis: its use in papillo-cyst adenomata of the ovary. *N. Orl. M. & S. J.*, Nov., 1934, *87*, 315–316.

Artificial pneumoperitoneum, which was formerly used extensively, has fallen into comparative disuse because of certain unfortunate complications which have attended its employment. There are certain cases in which paracentesis for the relief of ascites is imperative and it is in these cases that replacement of the ascitic fluid with air, and subsequent roentgenograms in various positions will afford welcome assistance in the problems of their diagnosis and management. Views made in many positions will give a survey of practically the entire peritoneal wall, demonstrating not only the original tumor mass but also metastatic peritoneal implants. The metastatic implants will appear as rounded or irregularly rounded masses of varying size. This is an obviously valuable finding for the management of the case.—*W. R. Brooksher.*

### GENITOURINARY SYSTEM

Gloor, Hans Ulrich. Über Verdrängungen der Niere bei Milztumor. (Changes in the kidney in tumor of the spleen.) *Acta radiol.*, 1934, *15*, 467–474.

Deformities of the kidney pelvis and displacements of the kidney that can be seen on pyelography are generally thought to be the result of tumors in the kidney bed, or of extrarenal retroperitoneal tumors. The author describes 2 cases which show that large tumors of the spleen, that is, intraperitoneal tumors, may cause similar deformities and displacements. This fact is not generally known.

Two types of displacement of the kidney

may be caused by tumor of the spleen, first a vertical displacement as the result of pressure of the spleen tumor on a floating kidney, and second, horizontal displacement toward the midline. Intimate adhesions between the capsules of the kidney and spleen are necessary to produce this second type of displacement. If the adhesions between the kidney and spleen are associated with relaxation of the physiological fixation of the kidney so that the spleen is adherent to a floating kidney, the transverse displacement of the kidney may reach an extreme degree. In the one case of this kind in the author's material the left kidney was displaced into the right half of the body.—*Audrey G. Morgan.*

SEGRE, MARIO. Sulla tecnica di esecuzione e sui criteri interpretativi degli urogrammi discendenti. (Technique and interpretation of descending urograms.) *Radiol. med.*, 1934, *21*, 325–392; 453–495.

The intravenous or descending method of pyelography gives information not only in regard to the morphology of the urinary tract but also in regard to its function, information that cannot be obtained by any other method of examination. In addition to that, it is perfectly harmless, while the ascending method is troublesome to the patient and in some cases actually injurious. The reason that descending pyelography has not been more commonly adopted is probably that it requires a very minute and careful technique in taking the pictures, and skill and experience in interpreting them, based on an accurate knowledge of the physiological findings in the kidneys and ureters on this method of examination before adequate comparisons with pathological conditions can be made. Not many physicians have mastered this technique both of taking the roentgenograms and interpreting them correctly but when they have done so this method will be of inestimable value in urinary diagnosis.

Thirty-four cases of normal and pathological findings on descending pyelography are described and illustrated with 84 roentgenograms and a long bibliography of the subject is given. —*Audrey G. Morgan.*

BALLENGER, EDGAR G., ELDER, OMAR F., and MCDONALD, HAROLD P. Collapsed bladder skiodan cystograms. *South. M. J.*, Nov., 1934, *27*, 938–939.

Skiodan cystograms with the bladder nearly empty present the following uropathic information: (1) large intravesical masses or bladder tumors, large intravesical protrusions of hypertrophied prostates and prostatic calculi; (2) diverticula of the bladder; (3) ureteral and pelvic dilatation, and (4) a fair estimate of the renal function as obtained by the rate of excretion of the opaque medium. For suspected vesical neck obstructions or bladder tumors, the solution may be injected into the bladder, using about 7 c.c. If injected intravenously, the roentgenogram should be made after the patient has voided.—*W. R. Brooksher.*

STELLE, C. W. Teratoma testis. *Arch. Surg.*, Jan., 1934, *28*, 1–11.

Of 620 cases of cancer studied at the United States Naval Hospital, 15 were found to be malignancies of the testis. All of these were histologically classified as embryonal carcinomas or teratomas. The author therefore emphasizes the incidence of this type of malignancy in the testicle; he calls attention to Ewing's opinion that the so-called "seminoma of Chevassu is not distinct from the malignant embryoma, but that it is an embryoma or teratoid tumor in which there is a one-sided cellular development resulting in a tumor made up of homologous cells with lymphoid stroma." The relationship of trauma to their etiology is questioned; only 2 of these 15 cases were associated with any type of injury. Differential features distinguishing these cases from hydrocele, syphilitic, tuberculous, gonorrheal or nonspecific orchitis are discussed. The importance of the Aschheim-Zondek test for prolan A content of the urine is emphasized, both as to preliminary diagnostic support and as to checkup of possibly residual elements after surgical or roentgen therapeutic attempts toward elimination of the lesions. Preoperative irradiation of the perineal region and multiple portals about the abdomen is recommended.—*A. A. de Lorimier.*

### NERVOUS SYSTEM

MCMASTER, P. E., and ROOME, N. W. Experimental lumbar sympathectomy. I. Effects on vascular tree, reactive hyperemia and temperature of skin of extremities. *Arch. Surg.*, Jan., 1934, *28*, 12–15.

Unilateral lumbar sympathectomies were performed on 11 dogs. Various observations were noted, over periods as long as 111 days thereafter. Thermocouple tests revealed temperature increases on the limb of the operated

side. These increases varied from 0.5° C. to as much as 2.0° C., the greatest elevations occurring in the paw, with a gradual tapering as to the variation so that the upper portions of the thighs showed practically the same temperature on the two sides. After three or four months these variations were reduced. Roentgenographic studies, after arterial injections, revealed no increase in the filling of the vessels of the operated side. It is conjectured that the vascular changes had probably taken place in the smaller arterioles and capillary beds.—*A. A. de Lorimier.*

Lewis, Dean, and Geschickter, Charles F. Tumors of the sympathetic nervous system. *Arch. Surg.*, Jan., 1934, *28*, 16–58.

Three general types of tumors of the sympathetic nervous system are discussed: neuroblastomas, paragangliomas and ganglioneuromas. Of these, the neuroblastomas were found the earliest in life, several cases having been reported in stillbirths, some of which showed metastases to the liver and spleen. Almost 50 per cent of the cases occurred before the age of three. Microscopically the lesions appeared as aggregations of small cells having heavily staining nuclei and poorly defined cytoplasm. The sites of occurrence where the primary lesions might be found include any of the avenues taken by the cells which wander out from the neural crest in the formation of the sympathetic nervous system, including the medulla of the suprarenal glands and paraspinal sympathetic ganglia. Clinically, many of the cases manifested fever, perhaps simulating rheumatic fever. Anemia and an abdominal mass were frequently noted. About 20 per cent of the cases showed bone metastases appearing as multiple small areas of rarefaction.

Paragangliomas were the most frequent type encountered. This group included diverse histological patterns. Some of the lesions were solitary and benign; others, multiple and malignant. Though they were all slow-growing, they resembled carcinomatous or sarcomatous tissue with the inclusion of numerous giant cells. The primary sites of these tumors might be found in the medullary portions of the adrenal, in the carotid body, the gland at the bifurcation of the aorta or even in the submucosa of the appendix or small intestine. The authors believe that many questionably "xanthosarcomas," "liposarcomas," "hypernephromas" and "giant cell sarcomas" really belong to this group. When involving the gastrointestinal tract these tumors are sometimes called "argentaffin tumors" or "carcinoids." All of these cases were found in adults, the most common period being between the ages of thirty-five and fifty. Clinical symptomatology varied according to the location of the lesion and the extent of the involvement; for instance, many of those located in the adrenals showed hypertension or hypotension with skin pigmentations; those in the carotid body presented chiefly the manifestations of pulsile tumors, while those involving the appendix presented typical appendicitis. Metastases were occasionally found in the regional lymph nodes or in the liver; very rarely in the bones.

Ganglioneuromas were found associated either with the sympathetics or the central nervous system. They were usually solitary and benign, though occasionally multiple and malignant. Cases of this type have been reported at all ages from four to forty-five. The development was usually slow and the symptoms variable according to the location, usually being mechanical in type. Histologically, these lesions are characterized by large ganglion cells and a typical neurogenic stroma.—*A. A. de Lorimier.*

Saito, Makoto. Normal shadow of the peripheral nerves and their pathological change in injury and tumor; roentgenological studies by means of thorium dioxide solution (thorotrast). *Am. J. Surg.*, Nov., 1934, *26*, 300–316.

Report is made of the injection of thorium dioxide solution endoneurally into the ulnar nerve, revealing not only the shadows of the nerve fibers, but also the internal and external sheaths of the nerve. For the procedure the arm is extended from the elbow and the sulcus N. ulnaris is located, punctured percutaneously with a thin needle, thus fixing the nerve. Then 0.5–1.0 c.c. of thorium dioxide solution is slowly injected. Roentgenograms are made at 24, 43 and 72 hour intervals following the injection, demonstrating the solution to proceed centrally along the nerve from the point of injection. The maximum visualization obtained was 39 cm.; the usual visualization of the ulnar nerve is 15 cm. Observations forty-five days later showed persistence of the solution within the nerve although there was disappearance of the shadow in the perineurium. Despite the retention of the solution, no pain or paralysis was noted from the moment of the injection. No

interference with function or after-effects attended the employment of the method. The application of the technique to the roentgen diagnosis of nerve injuries and tumors is discussed and illustrative case reports presented. —*W. R. Brooksher.*

SKELETAL SYSTEM

LIBERTI, RAFAELLO. Contributo clinico-radiologico alla conoscenza della lipoidosi colesterolica di Christian-Schüller. (Clinical and roentgen study of Christian-Schüller's cholesterol lipoidosis.) *Arch. di radiol.*, 1934, *10*, 13–49.

The author describes 2 cases of Christian-Schüller's disease which has been given many names in the literature. It is also called cholesterol lipoidosis and xanthomatosis, though as a matter of fact, xanthomatosis includes the xanthoma of diabetes, icterus and pregnancy, essential xanthomatosis, Gaucher's disease, Niemann-Pick's disease and Christian-Schüller's disease. The author refers for a thorough discussion of the subject to the work of Sosman in the *Journal of the American Medical Association*, 1932, vol. 98, No. 2. The first case was really described by Hand in 1893 and not by Schüller and Christian who did not describe their first 2 cases until 1915.

Schüller believed that it is caused by lesions of the hypophysis but Rowland in 1927 showed that it is due to disturbances of lipoid metabolism. Conditions similar to xanthomatosis have been produced in animals by giving a diet rich in fats and lipoids.

The author's first case was in a boy of seven who at the age of four began to suffer with polydipsia and passed a large amount of clear urine. A diagnosis of diabetes insipidus was made. A few months later he developed purulent otitis media and a swelling the size of a nut appeared in the temporal region. When he came to the author, examination showed the characteristic yellowish masses eroding the inner tables of the parietal, temporal and frontal bones. Roentgen examination showed defects not only in these bones but in the ribs and long bones. The serological examinations for syphilis were negative. At the ends of the femurs and tibias there were transverse stripes resembling those seen after successive attacks of rickets. This striation was seen in the second case also. The child had hydrocephalus and was retarded in physical development, looking like a child four or five years of age.

The second patient was a boy thirteen years of age in whom the disease had been developing since he was three. He showed the characteristic lesions of the bones of the skull and of the ribs, vertebrae, humeri, scapulae, pubes and femurs and also xanthomatous tumors of the lungs and liver. This child, too, had had diabetes insipidus at the age of eight years. Cholesterin was normal in the blood in both cases; calcium was increased in the second case. This child also had low blood pressure which might indicate lesions of the suprarenals. His head rested directly on his shoulders from lesions of the atlas and base of the skull.

The prognosis is hopeless so far as restoration to health is concerned but the disease is compatible with life for many years. Multitudinous treatments have been tried without success. Roentgen therapy only heals the bones that are irradiated, and the author finds from observation of his cases which have not been irradiated that some bone foci heal spontaneously while others develop, so it is hard to judge the results of treatment.—*Audrey G. Morgan.*

BRANCADORO, GIUSEPPE. Contributo radiologico alla conoscenza delle lesioni scheletriche insorte a distanza da un trauma. (Roentgen study of lesions of the skeleton developing at a distance from trauma.) *Arch. di radiol.*, 1934, *10*, 72–77.

A young man of nineteen came for examination of his right hand the fingers of which were irregularly swollen but painless both spontaneously and on pressure. The swelling had the hardness of bone and was covered with normal skin. It was impossible to flex the phalanges. When he was three years of age his fingers had been run over by the wheel of a wagon. The wounds healed in a few months and he had no further trouble until he was eight years old when the fingers began to swell, he had slight pain and it became more and more difficult to move his fingers. When he was eleven the pain stopped and the swelling did not progress any further but neither did it recede but remained stationary.

Roentgen examination showed the 1st, 2d, 3d and 4th metacarpals swollen and with a vacuolar appearance of the diaphyses; the outlines, however, were distinct. The 1st and 2d phalanges of the 3d and 4th fingers were enlarged, especially in the middle of the diaphyses and had a cystic appearance. The rest of the skeleton showed slightly subnormal calcifica-

tion. The right humerus showed a process of rarefaction which gave the bone almost a worm-eaten appearance and on the internal surface of the upper third of the diaphysis there was an exostosis. In the lower part of the bone the cortex was thinned and the marrow cavity enlarged. In the skull there was rarefaction of the frontal bone and slight thinning of the cortex of the parietal.

The author discusses the possible causes of this condition and concludes that it was most probably due to the trauma. Bone trauma may cause pathological changes ranging from simple bone cysts to true tumors. It is hard to see how this could have caused the changes in the humerus but the trauma may have caused bone trophism at a distance. This case shows how difficult it is to determine the medicolegal consequences of a trauma.—*Audrey G. Morgan.*

Bevilacqua, Luigi. L'indagine radiologica delle artrodie vertebrali nella colonna cervicale. (The roentgen picture of the arthrodial joints of the spinal column.) *Arch. di radiol.*, 1934, *10*, 182–188.

In the spinal column there are two types of joints, the amphiarthroses or articulations of the bodies of the vertebrae and the arthrodial joints in the true sense of the word, that is, true joints with flat joint surfaces covered with cartilage, a capsule and synovial membrane. There are two groups of these in the cervical segment of the cord, the unco-vertebral, situated at the lateral margins of the bodies of the vertebrae, described by Luschka and recently studied roentgenologically by Giraudi, and the vertebral arthrodial joints properly speaking, or the articulations of the joint processes, which are more important functionally. These are found at the two ends of a longitudinal column of bone a little back of the transverse processes between the peduncle and the lamina; the upper surfaces of the joint processes are turned backward and a little upward; the lower ones are almost parallel to these and therefore turned forward and downward; they are plane ovoid surfaces inclined at an angle of 45° to the horizontal plane of the vertebrae.

The joint interline therefore is inclined 45° to the horizontal. Since in the ordinary anteroposterior projection the central ray runs in the horizontal plane the joint line is not visible. To get an image of it the central ray must run in such a way as to be tangent to the interline, that is, it must cut the horizontal plane at an angle of 45°. Practically, however, instead of inclining the tube it is better to incline the antidiffusor diaphragm at that angle and have the patient rest his head on it, keeping the central ray vertical and aimed at the patient's forehead. A roentgenogram taken in this way gives interesting details in regard to the lateral and posterior parts of the vertebrae.

This method is very useful in the study of congenital malformations, juvenile ankyloses and arthritism of the vertebral processes.—*Audrey G. Morgan.*

Zuppa, Armando. La calcificazione del nucleo polposo intervertebrale. (Calcification of the intervertebral nucleus pulposus.) *Arch. di radiol.*, 1934, *10*, 250–261.

Before the introduction of roentgen examination calcification of the nucleus pulposus was confused with cryptogenetic radiculitis or syphilitic radiculitis, from which it differs distinctly.

A case is described in a man, aged fifty, who about three years ago began to have pain in the spinal column; it increased until he had difficulty in walking and was unable to stoop to pick anything up. Examination showed slight kyphosis painless on pressure. The lumbosacral tract was rigid. Long standing was painful. The Wassermann reaction was negative. Roentgen examination showed characteristic ankylosing spondylosis with marked ossification of the ligaments. Between the second and third lumbar vertebrae there was a lenticular opacity at the site of the intervertebral disc in the anteroposterior projection; it could be seen anteriorly in the lateral projection.

The author concludes that calcification of the nucleus pulposus is an independent disease shown in the roentgen picture by opacity of the intervertebral disc. Different authors have attributed it to ordinary infections such as typhoid, measles, scarlatina, etc., but there is little or no evidence of the truth of this theory. The opacities may be in the anterior or the posterior part of the intervertebral discs. The disease is closely related to ankylosing spondylosis by which it is sometimes accompanied. These calcifications of the nucleus pulposus may be due to a toxic, infectious or traumatic lesion of the sympathetic, which brings about changes in the lymphatics supplying the area and as a consequence a change in the trophism of a part of the spinal column. The changes may range from simple calcification of the nucleus pulposus or of the whole intervertebral

disc to calcification of all the ligaments.—*Audrey G. Morgan.*

DOLFINI, G. E., and BROVELLI, M. Risultati preliminari di ricerche linfografiche nella serie dei vertebrati. (Preliminary results of a roentgen study of the lymphatic system in vertebrates) *Radiol. med.*, July, 1934, *21*, 842–844.

The authors made a roentgen study in vivo of the lymphatic system of some of the lower vertebrates, using colloidal binoxide of thorium as a contrast medium. In a fish, a frog and a reptile they were able to demonstrate the greater part of the lymphatic system and later in addition to the spleen and liver, some blood vessels. In the guinea pig they demonstrated the lymphatic vessels of the hind leg and the popliteal and inguinal lymph glands, and later the iliac and para-aortic groups; in the rabbit the popliteal lymph glands with the afferent and efferent vessels, and iliac and para-aortic glands; in the dog the popliteal glands with the afferent and efferent vessels.—*Audrey G. Morgan.*

TARTAGLI, DINO. Trauma vertebrale e calcolosi renale secondaria. (Trauma of the spinal column and secondary kidney stone.) *Radiol. med.*, July, 1934, *21*, 814–819.

Lupacciolu has collected the cases which seemed to show that trauma of the spinal column may cause a secondary renal calculosis. He believes that the injuries of the spinal column interfere with normal elimination and in this way bring about the formation of stones.

The author describes a case in a man of thirty-nine who suffered an injury of his spinal column on August 2, 1931. A month after the trauma he showed signs of cystitis, and a probable diagnosis of cystopyelitis was made. Six months after the trauma he showed the first signs of renal colic, but it was not until June, 1932, that he had renal colic characteristic of true calculosis. At this time a roentgenogram showed the presence of stones. A first roentgenogram at the time of the injury had shown no evidence of stones. There was no doubt, therefore, that the patient had kidney stones after a trauma of the spinal column. The author does not believe, however, that the trauma caused the development of stones by interfering with elimination. He thinks the stones were caused by ascending infection from the pyelocystitis which may have been caused indirectly by the trauma.—*Audrey G. Morgan.*

MANARA, ACHILLE, Sulle ombre paracondiloidee interne femorali. (Internal paracondyloid femoral shadows.) *Arch. di radiol.*, 1934, *10*, 240–249.

The author describes a case in a patient who after a trauma of the left knee showed a shadow with rather indistinct margins near the internal condyle of the femur, though the condyle appeared to be perfectly intact. A comparative examination of the right knee showed the same kind of a shadow. The patient said he had had a similar trauma of the right knee two years before. There was an exostosis at the external border of the diaphysis of the right femur.

He discusses the differential diagnosis between fractures of the internal condyle and paracondyloid ossifications such as those seen in this case. Bistolfi in a recent article in the *Arch. ital. di chir.* has discussed the whole subject. He reported 767 cases of trauma of the knee in 78 of which there were changes of the internal condyle. Only 5 of these were fractures, the other 73 being post-traumatic ossifications. While in fracture the roentgen findings are positive immediately after the trauma, in post-traumatic ossification they do not become positive until after two weeks or more. In fracture there is always irregularity of the outline of the condyle itself, while in paracondyloid ossifications this is not the case. These ossifications are generally seen in cases in which the patient has had repeated slight trauma or direct contusion on the internal surface of the knee-joint or a fall with the knee in a valgus position associated with external rotation and flexion of more than 90°. There is pain at the internal condyle, limitation of movements of flexion and extension and interference with walking. In spite of massage for some weeks the symptoms continue and the roentgenogram which at first was perfectly normal shows a characteristic paracondyloid shadow. The condition frequently passes unobserved because the roentgenogram is normal at first.

The anteroposterior or posteroanterior projection gives the best results in studying these shadows, unless they are very close to the condyle in which case it is necessary to rotate the knee slightly outward. To study the epicondyle a slight movement of internal rotation should be made. A roentgenogram of the other knee should always be made for comparative study. The paracondyloid shadow may be separated from the condyle by a clear line of varying width or it may be attached to the condyle at

one of its extremities or even throughout its length. Paracondyloid ossifications may be associated with similar ossifications of a crucial ligament, osteophytes due to chronic arthritis or other lesions due to the same trauma, such as fracture of the upper end of the tibia or the internal condyle.

Indemnity is based not on the anatomical lesion but on the functional injuries caused by the trauma.—*Audrey G. Morgan.*

King, Don. Avulsion of the epiphysis of the small trochanter. *Arch. Surg.*, March, 1934, *28*, 561–565.

An avulsion of the lesser trochanter is described in the case of a fourteen year old boy; this report the author claims to be the sixty-second of its sort which appears in the literature. The accident occurred when the boy made a sudden stop, with his body extended, while playing baseball. Since most cases have presented similar histories the author suggests the term "sport injury." Boys between the ages of twelve and eighteen, are usually the afflicted, the particular epiphysis developing during that period. The patient complained of severe pain but was able to walk stiff-legged. The diagnostic clinical manifestation is the "Ludloff sign": an inability to flex the thigh actively when seated, but with the retention of active flexion when supine. Tenderness and swelling were noted in the upper inner aspect of the thigh and though the extremity could be manipulated freely for flexion or internal rotation it showed spasm to abduction or extension. Treatment consisted of immobilization of the thigh, for three weeks, at 45° flexion.—*A. A. de Lorimier.*

Bircher, E., and Oberholzer, J. Die Kniegelenkkapsel im Pneumoradiographie-bilde. (The knee-joint capsule in the pneumoroentgenogram.) *Acta radiol.* 1934, *15*, 452–466.

In continuation of their former work, the authors discuss the roentgen anatomy of the capsule of the knee-joint, and its anatomical variations. The first chapter is devoted to a brief summary of the biology of the synovia, the internal membrane and the joint capsule. They discuss traumatic changes in the joint capsule, Hoffa's fatty tissue, chondromata and osteomata of the joint, and the way in which inflammatory and non-inflammatory diseases of the joint affect the capsule. Their observations are based on material of 700 pneumoroentgenograms from the surgical department of the cantonal hospital of Aarau. They prove the great value of the injection of oxygen-perabrodil as an aid not only in the diagnosis of lesions of the menisci, crucial ligaments and synchondroses, but also in judging changes in the capsule itself.—*Audrey G. Morgan.*

Buschke, Franz. Morbus Köhler ähnliche Ossifikations-störungen am Cuneiforme I bei Zwillingen. (Disturbances of ossification similar to Köhler's disease in the first cuneiform bone in twins.) *Acta radiol.*, 1934, *15*, 502–507.

The author describes five pairs of twins who showed abnormalities in the ossification of the first cuneiform bone that could be demonstrated roentgenologically. In the twins developed from one ovum the lesions were found in both twins, while in those that developed from two ova they were found only in one, from which the author concludes that this must be a hereditary variation in ossification. The roentgen findings were very similar to those seen in juvenile osteochondropathy (Köhler's disease). Sometimes these subjects show symptoms, but very frequently they do not. These variations in ossification, therefore, are not necessarily pathological though probably they furnish a point of least resistance for various noxa. When there are such variations in the calcaneus, for instance, a long walk may cause symptoms. These variations in ossification are probably more frequent than is generally believed, and it is possible that they have the same etiology as the juvenile disturbances of ossification seen in Köhler's disease.—*Audrey G. Morgan.*

Stewart-Harrison, R. Ewing's bone sarcoma. *Brit. J. Radiol.*, Oct., 1934, *7*, 580–590.

While the clinical diagnosis of Ewing's sarcoma is uncertain, the roentgen appearances are very suggestive and the results of radiation therapy are conclusive. In the very early cases no roentgen changes whatever may be possible of detection, possibly a diagnostic point. Reduction in opacity, loss of structure, increase in breadth of the spongiosa and thinning of the cortex are seen in the early stages, and serve to differentiate osteomyelitis, often a source of confusion.

The test irradiation is almost pathognomonic but the high degree of radiosensitivity must not be confused with curability, as metastasis

is frequent. The prognosis is that of the metastases. Giant cell tumors are attended with a very slow sclerosis following irradiation and osteogenic sarcomas are proverbially insensitive. The test irradiation is preferable to biopsy as a means of diagnosis.

The histological structure, difficulty of microscopical diagnosis and treatment are discussed. Only when the results of radiation therapy are at least as good as those of radical surgery may it be preferred as the more conservative procedure. Localized to the extremities, high amputation may be employed. The other localizations are not amenable to surgery. The protracted-fractional method of irradiation is preferable.—*W. R. Brooksher.*

### BLOOD AND LYMPH SYSTEM

ALLEN, EDGAR V., and CAMP, JOHN D. The diagnostic value of arteriography. *Minnesota Med.*, April, 1934, *17*, 167–169.

Two cases of thrombo-angiitis obliterans are reported in which the ordinary methods of examination gave inconclusive information. The correct diagnosis was based almost entirely upon arteriography, a procedure which seems to have a wider application than has as yet been made of it.—*W. R. Brooksher.*

### GENERAL

BIGNAMI, GIUSEPPE, and FERRETTI, LUIGI. Le calcificazioni nei processi neoplastici. (Calcification in tumors.) *Radiol. med.*, June, 1934, *21*, 621–653.

The authors discuss calcium exchange under normal and pathological conditions, and review the numerous conditions in which abnormal deposits of calcium may form in the human body. Characteristic calcium deposits in tumors are not very frequent, but nevertheless a roentgen study of them furnishes valuable data in the differentiation of the different forms of tumors and in the roentgen demonstration of unsuspected tumors. This is the case, for example, in the calcium deposits which are very characteristic in fibromata and myomata, forms of tumor which develop slowly and are often latent clinically. The demonstration of calcium may help to determine the nature of the tumor as, for example, in chondromatosis and cysts of the thyroid. The nature and extent of the tumor may be determined by the roentgen demonstration of calcium. The different forms of tumor are discussed in the order of frequency with which they show calcification, beginning with chondromata and followed in sequence by fibromata and fibromyomata, cystic tumors, gliomata, vascular tumors including angiomata and endotheliomata, sarcomata, carcinomata, and cholesteatomata. Cases are described and profusely illustrated with roentgenograms. A long bibliography of the subject is given.—*Audrey G. Morgan.*

### MISCELLANEOUS

RUSCONI, MATTEO. L'esame craniografico pel confronto crociato delle immagini mastoidee. (Crossed roentgenograms of the mastoids.) *Arch. di radiol.*, 1933, *9*, 1037–1044.

The author describes and illustrates his technique for studying the mastoids. He uses what he calls an oblique vertico-cervical projection. The patient lies prone with his forehead on the center of the plate and then turns on one mastoid. The vertex is elevated about four finger breadths from the table, the shoulder resting on the table. The tube is inclined so as to take the picture in the cranio-caudad direction, avoiding the petrous bone. When a film has been taken in this position the patient turns to the opposite side and another is taken. This technique is of advantage on account of the rapidity with which roentgenograms can be taken with various incidences, which is necessary for accurate interpretations of the roentgenograms.—*Audrey G. Morgan.*

DAHL, BJARNE. Effets des rayons X sur les os longs en développement; étude radiographique et anatomique. (Effect of roentgen rays on the long bones during development; roentgen and anatomic study.) *J. de radiol. et d'électrol.*, March, 1934, *18*, 131–140.

The effect of roentgen rays on the osseous growth has been studied by Perthes (1903), Tribondeau and Récamier (1905), and many others. It has been demonstrated that the longitudinal growth can be easily influenced and even completely arrested at an early age by roentgen rays. The same applies to the transverse growth of the long bones and to the growth of the flat bones. The author has taken up these experiments in 1930 at the Cancer Institute of Paris and has continued them at the Radium Hospital of Norway at Oslo. In this article the modifications observed on roentgen films and on anatomic specimens are described in lengthy detail. The experiments

were performed on the hind legs of young rats of ten to eighteen days of age with roentgen rays of various intensity, the quality being 180 kv., 3 mm. Al. The material included 31 animals, 12 of which were sacrificed before the twentieth day after the irradiation and the others later up to a period of six months.

The following conclusions are reached: The first observation following irradiation is the clearing up of the medullary cavity of the epiphyses and diaphyses which is observed from the second to third day on and which corresponds to the destruction and resorption of the bone marrow. (2) Then follows a precocious calcification of the metaphyses and of the epiphyseal osseous nuclei, from the third to fourth day on. (3) A little later a devascularization of the metaphyses and epiphyses as well as of the periosteum and of the diaphyseal corticalis is noted. (4) The cartilaginous growth of the epiphyses resists the effect of the roentgen rays but the proliferation of the cartilage of union is arrested early. The early arrest of the endochondral and periosteal ossification shows a slight difference in sensitivity in the femur and tibia. (5) A very remarkable observation is the complete absence of evolutive transformation of the osseous tissue in the epiphyses as well as of the diaphyses, a phenomenon which is called the molding variation of the bone. (6) The progressive resorption of the irradiated diaphyses is observed from the fifth to the seventh day. (7) The fracture of the irradiated diaphyses is a constant phenomenon, there being no callus formation and the fragments resorbing. All this of course is due to the devitalization of the osseous tissue. (8) The perfect development of the irradiated femoral epiphyses despite absence of femoral metaphyses is considered as an argument in favor of the theory of autonomy in the evolution of various parts of the skeleton.—*T. Leucutia.*

Dahl, Bjarne. Calcification et troubles circulatoires du tissu osseux après irradiation aux rayons X. (Calcification and circulatory disorders of osseous tissue after roentgen irradiation.) *Presse méd.*, March 21, 1934, *42*, 471–472.

In a first article (see above abstract) the author presented his observations with roentgen irradiation of the hind legs of young rats. One of these observations concerned chiefly the early calcification of the irradiated osseous tissue. Because of its great importance, this observation was extended to some new experiments in which a dose of 1,500 r was administered within fifteen minutes and the animals sacrificed at regular intervals beginning within one hour after the irradiation, roentgenograms being made at definite intervals for the control of the calcification. It was observed that within three hours after the irradiation a densification of the epiphyseal nuclei and metaphyses had already occurred, the cortex always appearing considerably darker. The question arose as to whether this early densification of the irradiated bones is due to the deposit of calcium. To prove this in a second series of experiments vital staining with alizarin was used which, as is known, unites with the calcium in the tissues, representing, in fact, the only specific reagent of the said material. It was found that the staining of the irradiated bone appeared within eight hours following the irradiation if observed in transparent section and twenty-hours after, if viewed from the surface. Finally, in a third series of experiments lithium carmine was used as a vital stain to study the capillary imbibition of the tissues, as this stain after being uniformly distributed in the blood and tissue fluids imbues variously the tissues in the first twenty-four hours, depending on the type of tissue. It was observed that the irradiated bone specimens, when viewed from the surface presented a less intensive coloration than the opposite side, beginning from the second day and decreasing from day to day. It was thought that this progressive reduction of the coloration of the irradiated bone tissues with carmine is due to the capillary injury brought about by the irradiation.

Thus the general conclusion is reached that the early densification observed in roentgenograms following irradiation of bones in development is due to the deposit of calcium and that the capillaries of the osseous canals react more strongly and are more vulnerable to the irradiation than the cutaneous capillaries. The observation of Regaud and Ewing on the osteoradionecrosis showed pronounced calcification of the osseous tissue submitted to intense therapeutic irradiation. These authors, however, assumed that this calcification is due to modifications of the organic tissue elements, such as the alteration of the function of the osteoblasts. The author now believes that the effect is more direct and is most probably on a physicochemical basis. As is known, in normal and pathologic tissues a lowering of the pH

results following intense irradiation. Such a change is apt to favor the precipitation of calcium. Viewed in this manner, the calcification itself appears inoffensive for the ultimate life of osseous tissue. The circulatory disorder, however, is apt to lead to serious consequences such as necrosis, spontaneous fractures, etc.—*T. Leucutia.*

CAPUA, ANTONIO. Sullo studio dei linfatici della pleura, del polmone e del pericardio per mezzo di Thorotrast. (Study of the lymphatics of the pleura, lung and pericardium by means of thorotrast.) *Radiol. med.*, Feb., 1934, *21*, 119–135.

The author discusses a series of experiments in which he injected thorotrast into the pleura, bronchi and pericardium of dogs. He describes the diffusion of the contrast medium, showing communication between the lymphatics of the pleura and those of the abdomen and the lack of communication between the pleural and cervical lymphatics. There is communication between the two sides, as contrast injected into one side diffuses into the other.

He then tried a similar injection of thorotrast into the left pleural cavity in a man preceding a pneumothorax. This method cannot be used in current practice as it caused a pleural reaction and formation of an exudate. It showed, however, the exact course of the pleura in the various projections and clearly differentiated the pleura of the apex from all other structures in the region. In man, too, the contrast was diffused into the lymphatics of the abdomen.—*Audrey G. Morgan.*

REINHARD, M. C., and THIBAUDEAU, A. A. Development of multiple tumors in tarred and radiated animals. *Am. J. Cancer*, Feb., 1934, *20*, 380–386.

These investigators have practically corroborated the opinions expressed by Wagner and Castiglioni. They found that irradiation, (which was given in tremendous dosages) superimposed upon the effects of tar application to the skin of inbred albino mice, produced, after a period of about seven or eight months, very definite disseminated skin lesions. Microscopically these early appeared as sebaceous adenomata but later they showed malignant changes of the squamous cell layer with the formation of pearls beneath the basal layers. These lesions lacked the inflammatory reaction and the hyperkeratosis usually seen in the ordinary tar cancer. Many lesions were found in sites where no tar had been applied. The authors admit the possibility of casual pick-up of tar at these sites but suggest the possibility of a systemic reaction to tar intoxication.—*A. A. de Lorimier.*

PIRIE, A. HOWARD. An apparatus for reading with closed eyes. *Brit. J. Radiol.*, Feb., 1934, *7*, 111–116.

The author has designed a compact portable unit, weighing only 41 pounds, which is so designed as to visualize lead letters or figures to the closed eyes. He discusses practical adaptations of this unit especially for the ophthalmologist. Cooperation by the patient allows localization of foreign bodies in or about the orbit, or the recognition and localization of scotomata. Suggestions are made that the rays might be directed into the orbit whereby fluorescence upon foreign particles of glass might allow the ophthalmologist to recognize even splinters of it. Usage of the unit for an examination is limited to about two minutes because of the hazard of subjecting the patient to epilation.—*A. A. de Lorimier.*

ALLIBONE, T. E., BEETLESTONE, A., and INNES, G. S. A 300 kv. direct current generator using continuously evacuated rectifiers. *Brit. J. Radiol.*, Feb., 1934, *7*, 83–97.

The authors refer to the innovation of the continuously evacuated roentgen tube, particularly as they have designed it, having its anode terminal at ground potential. The present dissertation concerns the means of supplying a very high potential (over 200 kv.) "direct current" to such a tube. They cite the difficulties with most glass thermionic rectifiers, as to their voltage drop and limited safety factor to "stray capacities." To obtain greater constancy of valve action they recommend continuously evacuated thermionic rectifiers. These are designed similar to the continuously evacuated roentgen tubes; the terminals and end plates are of steel; the filament, of tungsten; the target may be cooled either by radiation or by a water stream; the walls are of porcelain, and the vacuum is obtained by an oil pump. The walls are fitted closely to the end plates by machine grinding and the use of vacuum grease but they are easily detachable so that changes may be made of the terminals or the wiring relations. Detailed description is given of the equipment and the possibilities of wiring designs.—*A. A. de Lorimier.*

FRED M. HODGES

PRESIDENT OF THE AMERICAN ROENTGEN RAY SOCIETY

1935–1936